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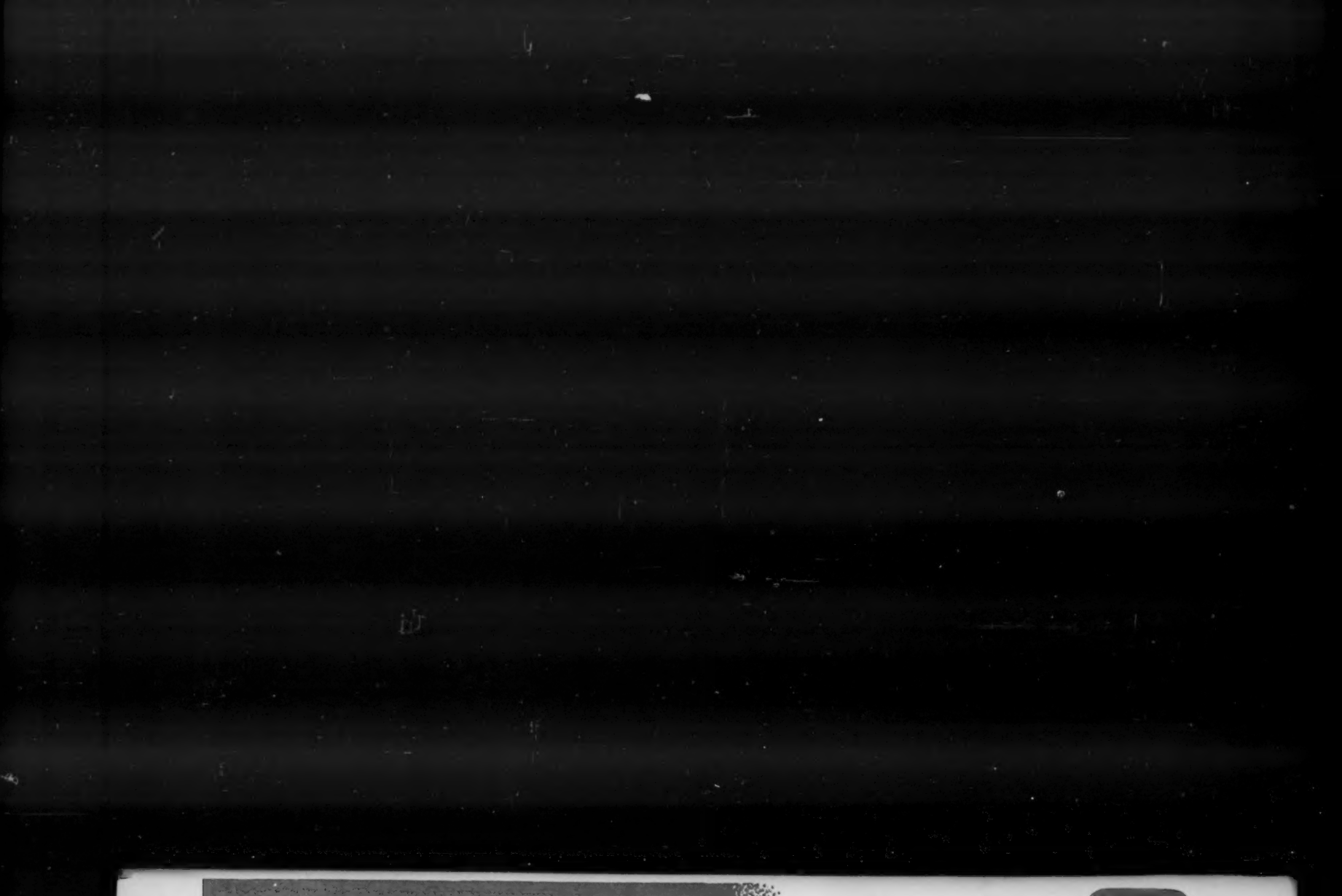

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Southern California Academy of Sciences

New Affiliate of the American Association for the Advancement of Science

THE Southern California Academy of Sciences was organized November 6, 1891, by a dozen scientists of the Los Angeles area from different fields of science. Originally called the Southern California Science Association, the present name was officially adopted in 1896. Later, in 1907, the Academy became incorporated.

The aim of the organization as stated in its first constitution was ". . . to secure a more frequent interchange of thought and opinion among those who devote themselves to Scientific and Natural History studies; to elicit and diffuse a taste for such studies where it is yet unformed; and to afford increased facilities for its extension where it already exists." To these ends public lectures by outstanding scientists were offered, publications were instituted, and sections were established for the scientific specialists.

In its early years, before the eastern scientific societies established contact in the West, the Academy filled a real need for the scientists in this area to meet and exchange ideas. The sections were very active, and held frequent field trips and discussion groups. Meeting monthly in general assembly afforded the opportunity to hear well-known scientists in other fields.

The first publications of the Academy were circulars, reports, and the *Proceedings*, which were published from 1896 to 1901. In 1902 the *Bulletin* was established and has appeared regularly since that date. It is now issued three times a year and is in its fifty-second volume (1953). A memoir series to accommodate larger monographs was instituted in 1938. The memoirs appear irregularly, as funds and appropriate scientific contributions are available. Both *Bulletin* and *Memoirs* are devoted entirely to technical scientific papers that deal largely with the Southwest. The *Bulletin* goes by membership, subscription, or exchange to about 350 persons or institutions all over the world.

The Academy was one of the four founding societies of the Los Angeles County Museum of History, Science, and Art, and collected the first fossils from the Rancho La Brea tar pits to be displayed there. It has maintained close contact with the Museum throughout the years. Monthly dinner meetings are held in the Museum from September through June. The various sections are responsible for the program for these meetings, and procure a representative series of speakers in the various fields of science. Speakers are chosen both for their scientific attainments and their speaking ability, and as a result the lecture series is of outstanding merit.

The Academy today is composed of about 175 active members equally divided between scientists and lay personnel. At least 80 per cent of the membership is local. Although comparatively small, the Southern California Academy of Sciences is entirely self-supporting. All activities and publications are financed by membership dues, sale of publications, and capital investments. Current officers are: President, Sherwin F. Wood, Los Angeles City College; 1st Vice President, Hildegarde Howard; 2nd Vice President, Kenneth E. Stager; Secretary, Lloyd M. Martin; and AAAS Council Representative, W. Dwight Pierce, all of the Los Angeles County Museum.

HILDEGARDE HOWARD
Southern California Academy of Sciences
Los Angeles, California

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Abstracts of Papers Presented at the Autumn Meeting,

November 9–11, 1953

Massachusetts Institute of Technology, Cambridge, Massachusetts

Properties of Gases at Extremely Elevated Temperatures

I. Amdur

Massachusetts Institute of Technology

Quantitative information concerning properties of gases at extremely elevated temperatures (of the order of 10^5 to 10^7 degrees Kelvin) in addition to its fundamental interest, is required in a variety of astrophysical problems and in certain problems dealing with combustion, detonation, and electric discharges in gases. The gas properties under present consideration include the transport properties, viscosity, conduction, and self-diffusion, and compressibility, as expressed by the second virial coefficient. Since direct measurements in the indicated temperature range cannot, in general, be made, and since long range extrapolation from low-temperature measurements may yield numerical values which are not even of the correct order of magnitude, a new approach is indicated.

In outline, the method consists of obtaining experimental information concerning the molecular interaction energies from the scattering of neutral particles of high energy (of the order of 200 to 2000 electron volts), and the use of this potential energy information in well-founded kinetic theory or statistical mechanical expressions to calculate the desired gas properties. The temperature range in which these properties are valid is determined by the range of interaction distance to which the derived potential energy information applies, and this, in turn, is determined by the geometry of the scattering system and the energy of the beam particles.

Results are presented for the gases, He, A, Ne, Kr, and Xe, which represent a favorable case because of the spherical symmetry of the intermolecular force fields and the almost completely elastic character of the molecular collisions. The presence of asymmetric force fields and the effect of inelastic collisions are discussed in connection with the use of the present method to obtain information for polyatomic gases.

The Dynamic Analysis of Low-Aspect-Ratio Airplane Wings

H. Ashley, H. M. Voss, and G. Zartarian

Massachusetts Institute of Technology

Unique problems are described which arise in the theoretical study of the effects of flexibility on dynamic flight behavior of modern aircraft wings with triangular, narrow rectangular and related planforms. A typical phenomenon is flutter, an oscillatory instability under fluctuating air pressures, where the wing deforms as an elastic surface in a complicated mode of vibration. The aerodynamic and structural tools necessary for successful prediction of flutter are outlined, with examples to illustrate certain pitfalls that may be encountered. Comparisons are presented between results obtained theoretically and in the wind tunnel for specific triangular and rectangular wings.

A discussion is given of difficulties which will have to be overcome during future research in this field, among others the more precise determination of structural properties and extension of existing aerodynamic theory. Improved techniques are suggested for stating and systematizing the equations of motion and their solution, including an alternative to the classical method of modal superposition.

Metabolic Effects of a Pituitary Extract

E. B. Astwood, M. S. Raben, I. N. Rosenberg, and V. W. Westermeyer

Tufts College Medical School

Purification of corticotropin by oxycellulose adsorption after hot glacial acetic acid extraction of pituitary glands yields a highly active preparation of enhanced clinical effectiveness. The product is virtually free from growth, thyrotropic, and gonadotropic activities and is rich in intermedin; the latter may be partially separated by any of several methods. A small quantity of crystalline spermine may be recovered from the extract. The preparation produces a number of metabolic effects, the factor or factors responsible for which have not yet been separated from corticotropin. In the fasting mouse, 3 μg causes a considerable mobilization of depot fat to the liver within three hours, the metabolic rate rises, and acetonuria occurs; in fed animals, the extract lowers the R.Q. These effects occur in adrenalectomized or hypophysectomized mice if they be maintained with cortisone. Larger doses protect the fed or fasted, intact or adrenalectomized mouse against the hypoglycemic and convulsive actions of insulin, but paradoxically the extract consistently lowers the blood sugar when given alone. The hypophysis is conceived as exerting an essential regulatory action in the normal utilization of fat during fasting and may thus be concerned in clinical states of over- and undernutrition.

Tensile Strength of Thin Metallic Films[1]

J. W. Beams, H. S. Morton, Jr., and E. F. Turner, Jr.

University of Virginia

The tensile strengths of thin films of silver and of copper have been measured as a function of their thickness. The experimental method consists in electro-depositing the metallic films on the cylindrical surface of a small diameter rotor and measuring the rotor speed at which the films are thrown off. The rotors are magnetically sus-

[1] Supported by the Navy BuOrd and OOR.

pended in a vacuum and spun by a rotating magnetic field in a manner previously described (*1*). In this way the stresses are applied to the film uniformly and tearing or stress concentrations are avoided. By using rotors of different diameters, both the tensile strength and the adhesion may be obtained. However, in most of the experiments the adhesion was made vanishingly small by thermally cycling the rotor from 90° to −70° C. Also, the adhesion was separately determined by electro-depositing the films on the rotor in circumferentially disconnected patches. The tensile strength of the silver films was found to be practically independent of thickness down to thicknesses between 3 and 2×10^{-5} in. where an abrupt increase of at least twentyfold occurred. These results are similar to the well known increased tensile strength observed in fine fibers and very thin sheets of mica (*2*, *3*).

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The Industrial Separation of Isotopes

Manson Benedict
Massachusetts Institute of Technology

The development of nuclear power plants has given importance to the separation of isotopes of a number of elements on an industrial scale. Individual isotopes of present or potential value include: D^2, Li^6, Li^7, B^{10}, N^{15} and U^{235}. There is also a substantial demand for C^{13} and O^{18} as tracers in research.

Uses of these isotopes and unclassified information regarding their production are reviewed. The principal processes for large scale separation of isotopes are described. It is concluded that distillation and chemical exchange are the most economical processes for separation of isotopes of the lighter elements. Gaseous diffusion and the gas centrifuge are useful for U^{235}.

The Shock Tube in Aerodynamic and Structural Research

R. L. Bisplinghoff and H. G. Stever
Massachusetts Institute of Technology

The shock tube has recently been developed as a tool for laboratory studies of gas dynamic phenomena. The well developed theories and practical applications of shock tubes are discussed. A shock tube design is described which is particularly suited for studying the effects of moving shock waves on structures. Applications of the tube to gas dynamic studies in the subsonic, transonic, and low supersonic ranges are discussed. In addition, applications to structural response problems arising from moving shock waves are described. Illustrations of results and data are given for some specific cases.

Some Reactions Involved in Biosynthesis of the Purines

John M. Buchanan
Massachusetts Institute of Technology

Studies have been carried out on the enzyme system responsible for the conversion of 4-amino-5-imidazolecarboxamide to inosinic acid in pigeon liver extracts. Recent experiments in this laboratory have shown that 4-amino-5-imidazolecarboxamide riboside may be formed from 4-amino-5-imidazolecarboxamide and ribose-1-phosphate in the presence of purified nucleoside phosphorylase. Greenberg has demonstrated that the carboxamide riboside may be phosphorylated by ATP to form the corresponding ribotide in the presence of dialyzed pigeon liver extract.

The third step, the incorporation of formate into the 2 position of the purine ring, has been studied in this laboratory by incubating pigeon liver extract with inosinic acid and radioactive formate. A preferential incorporation of radioactive formate into the 2 position of inosinic acid has been noted and the further observation made that the citrovorum factor stimulates this reaction. These data have been interpreted to mean that the purine ring of inosinic acid cleaves yielding 4-amino-5-imidazolecarboxamide ribotide which recondenses with radioactive formate to form inosinic acid-2-C^{14}. The citrovorum factor (formyl CoF) is believed to be the transformylating coenzyme.

The extract has been fractionated into two components by ethanol. The optimal incorporation of formate occurs only in the presence of both enzyme fractions. Components of this optimal system other than the enzymes are: inosinic acid, radioactive formate, boiled juice of pigeon liver and citrovorum factor. The stimulatory effect of the citrovorum factor on the reaction occurs only in the presence of both enzyme fractions.

Some Aspects of the Phase Problem in Crystal-Structure Analysis

Martin J. Buerger
Massachusetts Institute of Technology

The problem arising when attempting to find the locations of atoms in crystals can be appreciated by considering the formation of an image in the two-wavelength microscope. In this microscope the formation of the image takes place in two steps. The first step comprises the phenomenon occurring in the flow of light from the object to its diffraction image, the second step from the diffraction image to the final image. If light of two different wavelengths, λ_1 and λ_2, is used in these two steps, it is necessary, at present, to photograph the diffraction image and then build the final image by diffraction from the photographed diffraction image. Because of the break in the process, the phases of the light rays are lost. This phase loss also characterizes ordinary crystal-structure analysis. For many years it was believed that the phases could not be recovered. It is now known that, when studying discrete atoms, the phases can be found. Furthermore, the relation is now known between the true image and the image produced by assigning the same phases to all rays in the second stage. In x-ray analysis, this relation is used to solve the Patterson synthesis. An actual example of the use of this method of avoiding the phase problem is cited.

On Slow Viscous Flow

G. F. Carrier
Harvard University

The flow of a viscous fluid past an obstacle at low Reynolds number has been the subject of numerous analytical investigations. A rigorous analysis of the motion of the fluid requires the solution of a nonlinear problem, but

various attempts have been made to formulate an equivalent[1] linear problem. The work presented in this paper is a discussion of such a linear model which is closely related to the procedure introduced by Oseen. The results of the analyses of several specific boundary value problems using this model are presented and compared to those of the classical model of Oseen and Stokes. The results reported here are seen to be in better agreement with the physical facts than those given by the Stokes and Oseen theories.

Effects of Pyridoxal and of Indoleacetic Acid on the Transport of Amino Acids and of Potassium into Cells

Halvor N. Christensen and Thomas R. Riggs
Tufts College Medical School

Amino acids do not enter living cells by simple diffusion; instead they are actively transported into the cell interior against concentration gradients. This concentrating activity helps to determine how much of the various amino acids is captured by each tissue of an animal. We have found this process susceptible to study in free-cell neoplasms, specifically in the Ehrlich mouseascites tumor. Amino acids of all sorts are transported very actively into these cells, so that their concentrations may quickly come to be 10 or 100 times as great inside as outside.

In looking for clues as to the nature of this transport apparatus we have observed two substances, pyridoxal and indoleacetic acid, which considerably increase the extent to which glycine and other amino acids are concentrated by the cells. These two must work in different ways because supplying both at once in optimal amounts gives at least the sum of the effects of each alone. Their effects are related, however, in that indoleacetate combats an inhibitory action of desoxypyridoxine although it strengthens inhibitory effects seen with high levels (above 0.01 *M*) of pyridoxal. The effects of pyridoxal are seen somewhat more strongly in tumor cells from B_6-deficient mice. High glycine loads increase somewhat the level of pyridoxal which is optimally stimulating. What is particularly interesting is that pyridoxal has effects upon the maintenance of the cellular potassium concentration which parallel those upon glycine; at levels above 10 millimolar the tumor cells, and also erythrocytes, lose potassium more rapidly than they gain sodium; consequently the cells shrink. The erythrocytes thereby become more resistant to osmotic hemolysis. Shrinkage is also produced by indoleacetate.

Studies of the Site of Antibody Formation

Albert H. Coons, Elizabeth H. Leduc, and Jeanne M. Connolly
Harvard Medical School

Unequivocal evidence has accumulated in the last two decades that specific antibodies directed against foreign substances (antigens) gaining entrance to the animal body are synthesized primarily in the lymph nodes and spleen, at least in rabbits, guinea pigs, and mice. Closer study of the complex cellular changes in these organs following such a foreign stimulus has made it likely that this synthetic function is carried out primarily by one kind of cell, the plasma cell. By use of fluorescein-labeled antibodies, which form specific precipitates visible under the fluorescence microscope, both the foreign substance and antibodies directed against it can be localized to cells, and to parts of cells. With this method of observing the accumulation of antibody, we have shown that members of the plasma cell series in fact contain antibody. It has also been determined that the marked and long-known difference between the small response to a first stimulus and the great response to a subsequent stimulus is paralleled by the number of antibody-containing cells observed. The secondary response is characterized by cell multiplication, cell differentiation, and antibody synthesis.

These changes will be illustrated.

[1] "Equivalent" in the sense of yielding a solution closely approximating the vigorous solution.

Nucleon-Shell Effects in the Fission Yield Pattern

Charles D. Coryell and Alexis C. Pappas
Massachusetts Institute of Technology

The process of nuclear fission leads to a broad distribution of the fission products, centering for U^{235} neutron fission on mass numbers 95 and 139. Previous work has established the main features of the yield-mass curve and of the most probable charge and its distribution (i.e., independent yield along a decay chain) for a given mass ratio. The majority of these results come from quantitative radiochemical studies of the radioactive products. Mass spectrometric studies started in the school of H. G. Thode show the occurrence of fine-structure in yields, which is quite pronounced in the mass region 132–138. It is expected that effects should be observed from the occurrence of closed-shell effects for 50 and 82 neutrons and for 50 protons. This study was made to evaluate such effects in the fission yield pattern.

Data are presented coming from a search for new fission activities of antimony and a re-study of those of tellurium and iodine, with determination of cumulative and independent fission yields for as many species as possible. New species identified include: ~ 12m Sb^{130}, 23.1m Sb^{131}, 1.9m Sb^{132}, 4.1m Sb^{133}, and 0.8m $Sb^{134, 135}$, together with ~ 2m Te^{135}, the ground state of 63m Te^{135m}.

The pattern of independent fission yields leads us to modify the equal charge-displacement hypothesis of L. E. Glendenin to take into account discontinuities in probable charge associated with shell-regulated discontinuities in the pattern of stability. The cumulative fission yields for chains 130–140 show oscillations correlated with enhanced neutron boil-off for primary fission fragments with an odd neutron number above 82. Evidence is also deduced for the postulate of D. R. Wiles that closed-shell species have higher fission yields.

Recent Technical Applications of Karman's Vortex Wake

J. P. Den Hartog
Massachusetts Institute of Technology

The wake behind an obstacle in a fluid stream exhibits a regular pattern of vortices which are washed off the body periodically, alternately from the two sides, which gives rise to an alternating force on the obstacle in a direction perpendicular to that of the fluid stream. These vortices were described in the fifteenth century by Leonardo da Vinci; their frequency law is due to Strouhal (1878), and the geometry of their pattern was calculated by Karman (1911) for a circular cylinder. The intensity of the alternating force is only approximately known at present, especially for high Reynolds' numbers. When the frequency of vortex shedding (determined by the stream

velocity and the size of the object) is near a natural frequency of vibration of the object, large motions result which have led to structural failures. Important technical applications are electric transmission lines, submarine periscopes and large industrial smokestacks. The failure of the Tacoma, Washington, suspension bridge in 1940 was explained on this basis. Steel smokestacks for power stations are now reaching proportions which are unsafe in the wind, necessitating special damping devices.

High-Strength Plastics

Albert G. H. Dietz
Massachusetts Institute of Technology

High-strength plastics, composite structures of resins and high-strength filaments, are rapidly finding use in diverse applications like aircraft, body armor, fishing rods, watercraft, automobile bodies, and radar housings; they are entering the fringes of large-volume fields like building components.

Resins include phenolic, melamine, silicone, and the low-pressure polyesters. Fibers are usually fine high-strength glass filaments, but others, particularly nylon, are employed to meet requirements like high-energy absorption and abrasion resistance. Other synthetics and a variety of vegetable fibers and papers also find use.

Reinforced plastics are reasonably isotropic when fibers are randomly distributed as in a mat or molding, but reinforcement is often deliberately oriented to develop maximum mechanical properties in desired directions. Such materials are anisotropic, and the mechanics of Hookean isotropic materials do not apply. The more complex theory of anisotropic materials must be employed, but the additional complexity is offset by flexibility and freedom in tailoring strength properties to fit the stress conditions, and in modeling structural forms to fit the loads and space requirements.

Important problems remain. These include the meagerness of existing information respecting elastic constants and mechanical behavior, development of absolute intimate bond between resin and fiber, high costs, and improved fabricating techniques.

The Direct Observation of Hapten-Antibody Equilibria

Paul Doty and Samuel Epstein
Harvard University

On the assumption that antibodies are divalent, their reaction with divalent haptens should be formally equivalent to the polycondensation reactions of bifunctional acids and bases. This proposition can be examined directly by determining the extent of "polymerization" of antibodies as a function of the relative concentration of hapten. Since the contribution of the hapten to the weight average particle weight of a dilute solution of hapten-antibody aggregates is negligible the extent of polymerization can be determined directly from the measurement of this type of average molecular weight. Using light scattering methods to obtain this result the reaction of anti-arsanilic antibodies with two divalent arsanilic acid haptens has been studied. At the low concentrations (0.05% antibody) employed the average particle weight does not exceed twice the antibody molecular weight. As expected on the basis of the foregoing proposition the average particle weight is found to pass through a maximum as the hapten concentration is varied. The free energy of formation of the hapten-antibody bond in these systems is about 5.5 kcal in agreement with the estimates of Eisen and Karush based on equilibrium dialysis. In addition the light scattering techniques permit the study of the reversibility of the reaction, the inhibition by excess hapten (divalent and monovalent), the temperature dependence of the equilibria leading to the heat and entropy of the reaction, and to some extent the kinetics involved. All these explorations require purified antibody which is not susceptible to nonspecific aggregation. (The help of Prof. William C. Boyd was invaluable in obtaining such preparations.)

Matter and Radiation in Expanding Universe

G. Gamow
George Washington University

It was customary until recently to speak about "ponderable" matter, and "imponderable" radiation. Even after Einstein's proof that any form of energy, and in particular radiant energy, possesses a certain mass, the mass of radiation under any ordinary physical circumstances was considered to be negligible as compared with the mass of (atomic) matter. However, from the cosmological point of view, the situation appears rather different, and, in fact, we may say that during the early epochs of the evolution of our universe, the total weight of the radiations must have exceeded quite considerably the total weight of ordinary matter. While at the present stage of expansion the mean density of radiation in space may be only a fraction of a per cent of the mean density of matter, a more rapid variation of radiation density with linear dimensions (fourth power of linear dimensions, as compared with third power in case of matter) insures that sometime in the past radiation density was greater than matter density. Using the formula of the general theory of relativity, one can show that the demarcation point between radiation-governed and matter-governed universe corresponds to the age of $2.6 \cdot 10^9$ years (counted from the beginning $5 \cdot 10^9$ yr ago), and that during this era the temperature and density in the universe were 170° K, and $7.5 \cdot 10^{-27}$ g/cm³. During the radiation period of expanding universe its temperature, and matter density were given by expressions: temperature =

$$[1.5 \cdot 10^{10}\ ^\circ\mathrm{K}]/[\text{age in seconds}]^{1/2}$$

and $[4 \cdot 10^{-6}\ \mathrm{g/cm^3}]/[\text{age in seconds}]^{2/3}$.

Recent Observations on the Vasoconstrictor and Vasodilator Functions of the Sympathetic Nervous System[1]

Harold D. Green
Bowman Gray School of Medicine of Wake Forest College

In dogs, anesthetized with sodium pentobarbital, blood flow was measured separately in cutaneous and skeletal muscle vascular beds using an electromagnetic flowmeter.

The muscle vascular bed responded by marked dilation to: a brief period of ischemia, and to intra-arterial injections of acetylcholine, and of buffered solutions adjusted to either high or low pH. In contrast, the cutaneous bed dilated only in response to intra-arterial injections of solutions of low pH; it was poorly reactive to ischemia and to injections of acetylcholine and constricted with solutions of high pH.

Both cutaneous and muscular beds constricted in re-

[1] Supported by National Heart Institute, USPHS.

sponse to intra-arterial injections of both epinephrine and nor-epinephrine. Secondary dilation occurred in the muscle bed frequently after epinephrine and occasionally after nor-epinephrine. Electrical stimulation of the lumbar sympathetic chain caused constriction in cutaneous and muscular beds. Intra-arterial administration of adrenergic blocking drugs (Ilidar, Hoffmann-La Roche; Dibenzyline, Smith, Kline and French) blocked the constrictor response in skin to sympathetic nerve stimulation and to intra-arterial injections of either epinephrine or nor-epinephrine. In muscle beds the adrenergic blocking drugs abolished the constrictor response to nor-epinephrine, and to nerve stimulation and converted the response to epinephrine to marked dilation. Only Dibenzyline converted the constrictor response to nor-epinephrine to a mild dilator response. Consistently the blocking drugs unmasked a dilator response to sympathetic chain stimulation. This dilator response to sympathetic nerve stimulation, was always blocked by intra-arterial injections of atropine, whereas the dilator responses to epinephrine and to nor-epinephrine were unaffected. Recent evidence suggests that the sympathetic constrictor fibers are under the control of the medulla and carotid sinus reflexes, whereas the dilator fibers are controlled by the hypothalamus and cerebral cortex.

The blood vessels in skin are under the tonic constrictor control of the sympathetic nervous system only; they respond poorly or not at all to local metabolic influences. The blood vessels of muscle are also under the tonic constrictor control of the sympathetic system, but unlike skin, they may be dilated by sympathetic cholinergic fibers, and by a variety of local metabolic influences. The sympathetic constrictor impulses appear to be mediated by a nor-epinephrine-like substance.

A Late Pachytene Chromosome Map of the Male Mouse

A. B. Griffen
Roscoe B. Jackson Memorial Laboratory

Through the use of permanent squash preparations, made from the seminiferous tubules of young male mice and stained with aceto-carmine, acetic orcein and Sudan Black B, a provisional chromomeric map of the synapsed meiotic chromosomes has been constructed. The twenty pairs of chromosomes appear as well-defined bodies whose serial alignment of chromomere rows has made possible the drawing, study, and identification of the several elements of the chromosome complement. The plasmosome organizer is a part of the XY chromosome pair, the large plasmosomic nucleolus making possible the ready identification of the sex chromosomes. Chromosomes V and VIII have been identified through the use of Snell's translocation (5-8)A; all other autosomes have been assigned identifying letters pending the discovery of linkage group identity through the use of irradiation experiments. The chromomeric map differs in detail and in interpretation from Slizynski's earlier "banded" map of the mouse. The present map shows a total of 471 chromomeres, while the "band" map shows 817 transverse lines; however, the two systems can be somewhat reconciled if the vesiculate chromomeres are counted as two bands each and the punctate chromomeres as one band each, making a total of 757 apparent bands for the chromomeric map. Many of the structures which are delineated in the new map are at or near the limits of resolution of the compound microscope; the use of oblique illumination has made possible the detection and study of these small bodies and is quite necessary for success in the use of the map as a guide for further cytogenetic investigations.

Acoustic Orientation in Tropical Bats

Donald R. Griffin
Harvard University

Laboratory and field studies of bats in Panamá, including species that feed on insects, fruit, fish, nectar of flowers, and blood of living animals, showed that they all emit pulses of high frequency sound and appear to use types of acoustic orientation similar to that previously described in the insectivorous bats of the family Vespertilionidae. Frequencies ranged from 15 to 60 kc and tended to be correlated inversely with the size of the bat. The common fruit-eating bat *Corollia* (family Phyllostomidae) is characterized by a spear-shaped nose leaf somewhat similar to the "horseshoe" of the European horseshoe bat *Rhinolophus*; but *Corollia* produces sounds resembling more closely those of the Vespertilionidae (which have no nose leaf) than the long duration, constant frequency pulses of *Rhinolophus* recently described by Möhres. The pulses may have some frequency modulation and are emitted through the mouth, as in the Vespertilionidae, rather than through the nostrils as in *Rhinolophus*. The fish eating bat *Noctilio* emits complex high frequency sounds while fishing, and some of this sound can be detected by an underwater hydrophone. The possible significance of these sounds will be discussed with reference to the diversified feeding habits of these bats.

Electron Emission and Breakdown

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Massachusetts Institute of Technology

For d.-c. voltages and gas pressures below a few atmospheres, Townsend's breakdown criterion applies, which makes the regeneration of the starting electrons the decisive issue. At high gas pressures and in crystals, we find electron emission commencing at fields as low as 10^5 v/cm. Since an ample electron supply is thus assured, new types of instability conditions become valid. In the presence of electron emission the onset of impact ionization, and conversely, in the presence of impact ionization the onset of electron emission, may lead to breakdown due to the contraction of the field by space charges. Stabilization, before the spark stage is reached, may be possible in certain cases if an effective electron trapping mechanism interferes. Various aspects of the stability of dielectrics in the presence of electron emission are discussed for gases, liquids and solids.

Molecular Vaporization of the Group IVB Elements

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Radio Corporation of America

Although it has been common knowledge that some elements in Groups VB and VIB vaporize in molecular form, similar information concerning the Group IVB elements has, to date, not been available. The present paper deals with the elements carbon, silicon, germanium, tin, and lead which were studied in a Dempster-type, 180° mass spectrometer. A small sample of the element under study was thermally vaporized (carbon by direct electrical heat-

ing, the others heated in suitable crucibles); the neutral particles coming off were bombarded with low-energy electrons; and the resulting positive ions were mass-analyzed.

The mass spectra obtained show that each of the Group IVB elements produce molecular as well as atomic species in the vapor phase. Exact quantitative evaluations are difficult as long as fragmentation patterns and relative ionization cross-sections are not known. The sublimation of graphite is of special interest because the C_3^+ ion was found to predominate, and molecules containing up to eight carbon atoms were detected. Even though heats of activation could be measured for the three most abundant species C_3, C_2, and C_1, no definite conclusion was reached concerning the atomic heat of sublimation of graphite.

The other four elements yield, upon vaporization, mainly monatomic species and lesser amounts of polyatomic molecules. Thus, in the vapor phase of germanium were found clusters containing up to seven atoms and comprising about 20% of all the particles. Similarly, polyatomic tin clusters were observed, while diatomic molecules were found for silicon and lead.

Reproduction of an Animal Virus

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The development in this laboratory of a photometric technique which permits precise enumeration of certain animal virus particles made possible quantitative investigations on the reproduction of these infectious agents. Influenza viruses are reproduced in discrete cycles of about 6 to 8 hours' duration. Successive cycles result from the sequential infection of separate host cells. The yield is approximately 100 virus particles per cell. Only complete, fully infective particles emerge from infected cells. No evidence for the emergence of immature, noninfective particles was obtained. The ratio of total to infective particles on emergence is constant and approaches a value of 1.0.

The rate of emergence of newly formed particles is constant and independent of the number of infective particles inoculated. The generation time, i.e., time to double the number of particles, is about 60 minutes. Infective particles become noninfective rapidly in a manner indicative of spontaneous decay. Under conditions existing in the infected host, the half-life of infective particles is about 150 minutes. Noninfective particles block susceptible cells and prevent the reproduction of infective particles. The proportion of cells blocked is a function of the ratio of noninfective particles to susceptible cells. When this ratio has a value of about 8, reproduction is prevented. With values for the ratio smaller than 8, the rate of emergence of newly formed particles is decreased. When the generation time is increased in this manner until it is equal to or longer than the half-life, no infective particles appear although reproduction is still occurring.

Electronic Energy in Solids

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The treatment of the motion of an electron in the periodic potential field as found in a crystal is discussed. Various recent approaches to the solution of this problem by use of the orthogonalized plane wave method and of the cellular method have shown results comparing favorably with x-ray emission data; it is shown how, from a limited number of accurate results calculated by such methods, detailed knowledge of the energy density of electronic states may be derived. Such approaches indicate the real possibility of obtaining, by existing methods, quantitatively accurate energy band schemes in solids.

The use of these calculations in considering certain physical properties of solids is discussed. An outline is given of the theory of the elastic constants of solids, which energy band theory has proved capable of explaining the electronic properties of the transition metals are also amenable to treatment, and indicate the need for accurate rather than approximate knowledge of the energy density of electronic states. Another application is to the calculation of the cohesive energy of various metals; also, recent calculations of the compressibilities of metals have been found to be in good agreement with experimental data.

The Nature of the Electrical Conductivity in the Earth

Harry Hughes
Harvard University

The variation of the electrical conductivity through the Earth is inferred from the induced effects on currents in the ionosphere and on the secular geomagnetic variation. An analysis of the distribution found shows it to be due to the Earth's mantle being a semiconductor and increasing in temperature with depth. Experiments have been made on suitable minerals at high temperatures and they are found to be semiconductors of the magnitude estimated with both electrons and metallic ions as the conducting particles. Which conducts in the Earth is still uncertain due to the unknown effects of pressure, and on the correct choice of mechanism depend estimates of the temperature and composition of the Earth's interior and theories of the origin of the geomagnetic field.

An Analysis of Coat-Color Inheritance in the Dog

C. C. Little
Roscoe B. Jackson Memorial Laboratory

An analysis of coat-color inheritance in dogs is based on over 2,000 animals raised at Bar Harbor and on data on about 20,000 animals derived from several thousand cooperative breeders elsewhere.

The basic loci involved are as follows:

1. A^t=self color, a^w="wild" color, a^y=tan, a^t=tan points;
2. B=black, b=brown;
3. C=full pigment, c^{ch}=pale "chinchilla";
4. D=intense pigment, d=Maltese dilution;
5. E=extended pigment, e^{br}=brindle, e=restriction (red or yellow);
6. G=dominant gray dilution, g=its absence;
7. M=dominant merle or dapple, m=its absence;
8. P=dark eye pigmentation, p=pink-eyed dilution;
9. S=solid pigmentation, s^i="Irish" spotting, s^p=piebald, s^w=extreme white piebald;
10. T=dominant "ticking," t=its absence.

These are all clear Mendelian genes. Their expression and interaction are discussed.

Soundfield Due to a Rotating Airfoil

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Massachusetts Institute of Technology

An exact relation is derived for the acoustic field due to a rotating airfoil. The near zone field predicted by this relation differs appreciably from that determined by conventional studies which neglect nonlinear phenomena. The far field, on the other hand, is in substantial agreement with the results of previous approximate formulations and is found to be adequately described by lines of rotating dipoles. The study is restricted to subsonic speeds.

Population Structure, Dispersal, and Species Formation

Ernst Mayr
Harvard College

The roles of mutation and selection have been duly stressed in discussions of evolutionary change and of species formation. Much less is known so far about the role of one of several other factors affecting speciation, namely the population structure of species. This in turn depends on dispersal faculty and survival at different stages of the life cycle, on the mating system, on the length of generations, on changes in population density from year to year, and on various other ecological factors.

The most important of these factors seems to be the dispersal faculty, which might be defined as the ability of individuals of a species to overcome extrinsic barriers. In species with easy dispersal there is much intermingling of individuals from different populations. This results in considerable genetic and morphological uniformity over extensive geographical areas and in a low rate of species formation.

In species with low dispersal faculty populations become isolated from each other more easily and more effectively, and many of the isolated populations may, in the course of time, reach species level. The rate of species formation tends to be high in such forms. A special case is presented by types which normally have a low dispersal faculty, but are subject to occasional long distance dispersal, like certain types of land snails. Exact data on the rate of species formation of such forms are not yet available.

If species formation is defined as the origin of reproductively isolated populations, it is probable that in animals the rate of species formation is as much or more so a function of the ecological characteristics of populations (including dispersal) than of such purely genetic factors as mutation pressure.

The Distribution of Charge in Molecules and Crystals

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The form of the "electron charge cloud" in a molecule or crystal is of importance for two main reasons. In the first place, the charge density function helps us to understand the origin of the binding energy of a system and secondly, many of the properties of a system depend directly on the general disposition of charge within it. Starting from a given set of basic atomic orbitals, the charge density P may be calculated on any orbital theory: we may start with simple molecular orbital theory, adding configurations to improve the approximation, or from valence-bond theory (though more conveniently in a revised form) including finally all possible polar structure; and the predicted expression of P must ultimately agree. By appeal to the form of P it is possible to give very general and unified definitions of "bond order" and of "atom" and "bond" charges.

Two samples are given of the value of atom and bond charges. They determine the general form of the field outside a molecule and hence long range interaction and the early stages of chemical reactions. And in a crystal, where the coherent x-ray scattering is calculable directly from P, they allow us to define such quantities as an "effective atomic scattering factor" for a bonded atom.

Hardness and Atomic Structure

E. Orowan
Massachusetts Institute of Technology

The hardness of ductile crystalline materials, determined by their yield stress, may be due to one of two causes. Either it arises from the presence of obstacles hindering the movement of dislocations: other dislocations, inclusions, and foreign atoms, may act as obstacles. Or it represents the shear stress required to move a dislocation in an otherwise faultless crystal. It was usually assumed in the theory of plastic deformation that dislocations could move under very small stresses in a good crystal, and that any hardness a crystalline material may possess was due to the interaction between dislocations, or the action of various obstacles.

It can be demonstrated in the case of diamond that its high hardness cannot be due either to the complete absence of dislocations, or to their presence in extremely large numbers. The hardness therefore must arise from a very high value of the shear stress required for moving a dislocation in the lattice. The strong directional bonds of diamond, if acting across the slip plane in the dislocation, would explain why the movement of the dislocation requires high stresses. Very high values of the lattice energy (intrinsic pressure) would give the same effect.

In the case of metals, strong directional forces and high lattice energies are to be expected if many unpaired electrons are present in the outermost d-shell. Inspection of the periodic table shows that in fact all common hard metals, with the obvious exception of beryllium, satisfy this condition; those with intermediate numbers (3 to 7) of outer-shell d-electrons are: V, Cr, Mn, Fe, Co; Nb, Mo, Ma, Ru; Ta, W, Re, Os, Ir; Pa, U. This remarkable relationship between hardness and atomic structure has already been noticed by Pauling (*1*); its direct cause is apparently the high stress needed for moving dislocations.

In a certain temperature range, thermal energy becomes sufficient to overcome the interatomic forces opposing the movement of the dislocation. In this "dislocation softening range," analogous to the softening range of glasses, the yield stress must show a considerable temperature- and velocity-dependence. Below the softening range, the material is hard; at temperatures high above it, the initial hardness of the unstrained crystal is very low, often insignificant compared with the hardness acquired by plastic deformation, and both are relatively little dependent on temperature and rate of deformation.

Reference

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The Brittle Fracture of Ductile Steels

E. Orowan
Massachusetts Institute of Technology

The classical Mesnager-Ludwik theory attributes brittle fracture in normally ductile steel to triaxiality of tension due to plastic constraint by a notch or crack; in a triaxial state of tension, the highest tensile stress can be higher than the uniaxial yield stress, and it may reach the value of the brittle fracture stress even if the yield stress is lower than this.

Experiments carried out by Dr. D. K. Felbeck and the writer have shown that a brittle crack produced in a low carbon steel plate at liquid nitrogen temperature does not propagate as a brittle crack under static tension at room temperature: instead, intense localized plastic deformation occurs at the tip of the initial brittle crack, followed by the formation of a very short fibrous crack which then suddenly changes over to a cleavage crack running across the plate at high speed with little if any plastic deformation. The most obvious interpretation of this phenomenon is that, in cases of typical brittle fracture, the tensile stress can reach the level of the brittle strengh because the yield stress of iron is raised very considerably by high velocity of deformation. If a crack runs rapidly, therefore, the yield stress can rise above the brittle fracture stress with little or no triaxiality of tension. This must be the cause of any highly brittle fracture in a ductile steel, because a significant triaxiality due to plastic constraint would have to be preceded by considerable plastic deformation.

The Rapid Measurement and Recording of Osmotic Pressure

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Osmotic pressure is generally considered in terms of equilibria established across ideal and semi-permeable membranes. Hours, days or even months are required to attain equilibrium conditions across artificial membranes in conventional osmometers. In this communication we shall describe an instrument which measures and records osmotic pressure in a matter of seconds. The instrument has been developed to study transient osmotic forces during the diffusion of solutes through nonideal membranes which restrict, but do not prevent entirely, the passage of solute molecules. Osmotic transients of this type occur continually in living systems and are specially important to the exchange of water and dissolved materials through capillary walls. They are important also for determining the mean molecular weight of polydisperse polymers such as Dextran.

Two small osmometers of the Hepp type are arranged in parallel and the solutions on the underside of each membrane are connected to each side of a differential conductance manometer. This manometer combines great sensitivity and stability with a low volume displacement (0.0023 mm^3 per mm Hg). A high pressure is applied to the solutions on the top of each membrane, thus firmly pressing each membrane upon its supporting surface and causing filtration into the two halves of the conductance manometer. If the solutions and membranes in each osmometer are identical then no differential pressure arises during the filtration process. However, if a solute is added to one osmometer and this solute is restricted relative to solvent in its passage through the membrane then a differential (osmotic) pressure arises which is sensed by the conductance manometer and recorded on an oscillograph. For large solute molecules such as plasma proteins, which do not pass through the membranes, the half-time for development of pressure is about 5 seconds and equilibrium is 95% complete within a minute.

Auto-Mutagenesis in the Mushroom, *Schizophyllum commune*

John R. Raper, *University of Chicago*

In *Schizophyllum commune*, a typical member of the higher fungi and characterized by tetrapolar sexuality, obligatory crossmating is imposed and controlled by incompatibility factors at two loci, *A* and *B*. Each fruit accordingly produces progeny of four distinct mating types. Fertile matings occur between strains of these diverse mating types only in those combinations which yield the double heterozygote. In other combinations having *A* or *B* factors in common, heterokaryons—mycelia containing genetically dissimilar nuclei—of a unique type are formed. The common-*A* heterokaryon, which is stable and capable of indefinite vegetative growth, induces mutations in its component nuclei in frequencies up to 10^6 times the spontaneous rate for the same mutations in homokaryotic strains. These mutants belong to a limited number of distinct morphological types (about 10), each type differing from wild by a single, characteristic, altered locus. The age of the heterokaryon and the genetic history of its component strains determine mutation frequency and, to a lesser extent, the types of mutations induced. Available evidence indicates that heterokaryotic mutagenesis is an auto-induced process operating through the normal production of a mutagenic agent(s) which preferentially affects a limited number of loci in a regular and predictable manner.

Molecular Motion in Silicones

Eugene G. Rochow, *Harvard University*

While the chemical properties of the silicone polymers may be explained quite satisfactorily on the basis of their chemical composition, the distinctive physical properties of these polymers require some explanation in terms of molecular structure. Two theories have been advanced: one assumes rather tightly coiled linear molecules in the silicone polymer and postulates some uncoiling with increase in temperature, while the other theory postulates an extreme degree of motion of the dimethylsilyl groups about the silicon-oxygen bond. The first theory explains the small temperature coefficient of viscosity by the compensating uncoiling mechanism; the other theory explains the same property (and many others) by increased intermolecular distances and correspondingly smaller intermolecular attraction.

In the present investigation the method of nuclear magnetic resonance absorption is applied to the study of molecular motion in a number of pure organo-silicon compounds as well as in silicone polymers. Comparison of the observed proton absorption lines with those predicted by quantum mechanical theory indicates that there is an unusual amount of motion of the methyl groups in methyl silicones, but that this motion is confined in large part to rotation of the methyl groups about the carbon-silicon bond. The results point toward some modification of the free-motion theory, and should be useful in predicting the properties of related compositions.

Cosmic Ray Results on the New Unstable Particles

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Massachusetts Institute of Technology

In the last few years, cosmic-ray studies have revealed the existence of many new fundamental particles. Some of these particles are heavier than nucleons, some are lighter than nucleons but heavier than π-mesons. The names of *hyperons* and *heavy mesons* have been suggested to designate the two groups.

There is clear evidence for the existence of a neutral hyperon decaying into a proton and a negative π-meson, with a mean life of about 3×10^{-10} sec:

$$\Lambda^\circ \rightarrow p^+ + \pi^-.$$

There are also strong indications for the existence of a charged hyperon decaying into a neutron and a charged π-meson:

$$\Lambda^\pm \rightarrow n + \pi^\pm.$$

The existence of at least two different kinds of heavy mesons appears to be fairly well established. Among them there seem to be particles which decay into two π-mesons:

$$\theta^\circ \rightarrow \pi^+ + \pi^-.$$

No definite statement can be made as yet concerning the decay scheme of the other neutral mesons.

The experimental situation concerning the charged heavy mesons is still very obscure. There certainly exists a charged heavy meson which decays into three π-mesons:

$$\tau^\pm \rightarrow \pi^\pm + \pi^\pm + \pi^\mp.$$

There also are charged heavy mesons whose charged secondary products are single light mesons (π- or μ-mesons). In some cases, at least, photons are present among the decay products of these particles. The following decay schemes have been suggested:

$$\kappa \rightarrow \mu + (2 \text{ neutral particles})$$
$$\chi \rightarrow \pi + (1 \text{ neutral particle})$$

It is not known at this time how many different kinds of charged heavy mesons exist. One must consider the possibility that a given type of particle may have several alternate decay schemes.

Interpretation of High Energy Experiments

Robert Serber, ***Columbia University***

Since the development of high energy accelerators which took place shortly after the war, a great deal has been learned of the behavior of matter in this new domain. Cosmic ray research too, by its discovery of many new particles, has revealed a richness of nature rather embarrassing to the physicist attempting to reach some further understanding. The successes of theoretical physics have been limited, and of a rather limited kind. They are based almost entirely on general, well founded, and unspecific principles, such as the conservation of energy, momentum, angular momentum, and parity. They thus have to do with the symmetry properties of the equations satisfied by nucleons and mesons, rather than with the explicit forms of the equations themselves, and still less with their explicit solutions. Experiments with low energy π-mesons strongly indicate the existence of an additional symmetry property: the principle of charge independence, which relates the behavior of charged and neutral mesons. For low energy mesons, the conservation laws so limit the available quantum states that a reasonable, if incomplete, picture of what goes on may be obtained. This is no longer true at the high energies of the Brookhaven Cosmotron, or of the cosmic rays, where the characteristic phenomena become the multiple production of mesons and the production of new types of particle. Pais is attempting to integrate the principle of charge independence more deeply into the theory in the hope of discovering the relationships between the many particles which may exist. Meanwhile, the more heuristic approach used by Fermi, based on phase space arguments familiar in statistical mechanics, is being actively pushed as a basis for the discussion of the rapidly developing experimental results.

Plastic Flow in the Cutting and Grinding of Materials

Milton Shaw
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While quantitative studies of cutting operations designed to improve the efficiency of metal removal operations are of considerable industrial importance, the results of such studies also yield information concerning the basic behavior of materials that is not readily obtainable from more conventional materials tests. Photomicrographs of partially formed chips reveal that ductile metals are normally cut by a process of shear flow that is confined to a relatively small volume of metal in the vicinity of the point of the tool. The smallness of volume deformed at any one time makes it possible to investigate the influence of specimen size upon flow behavior and at the same time to carry out tests at relatively high rates of strain. Cutting tests performed over a wide range of specimen size suggest that a size effect is generally operative in the plastic flow of materials. The size effect so readily evident in metal cutting will be shown to pertain to a lesser extent to the ordinary torsion test, to bend tests, and to microhardness testing. The size effect concept also explains the empirical rules of comminution of normally brittle materials. While this explanation lends to essentially the same relationships for the energy required to pulverize materials it focuses attention on the quantities that are physically responsible rather than on the relatively trivial concepts originally invoked by von Rittinger and Kick to explain grinding energies. From the new point of view the controversial rules of von Rittinger and Kick normally considered to be incompatible are found to hold for relatively large and small particle sizes respectively.

Experimental Results with the Brookhaven Cosmotron[1]

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Brookhaven National Laboratory

The Cosmotron presently is capable of accelerating protons up to energies of 2.25 billion electron volts. When these protons are allowed to strike a solid target, beams of high-energy secondary particles can be produced. These particles and their interactions with matter are being investigated by means of scintillation counters, nuclear emulsions, and cloud chambers, by a number of groups. High energy neutrons and protons when colliding with another single proton appear usually to produce several π-mesons simultaneously. π-mesons, believed to be responsible for nuclear forces, are known as unstable particles whose mass is 276 times that of an electron (as com-

[1] Work performed under the auspices of the U.S. Atomic Energy Commission.

pared to 1840 electron masses for neutrons or protons). A study of their interactions with neutrons and protons, and with each other, should lead to a better understanding of the nuclear forces. π-mesons are capable of producing several other π-mesons in one collision. They have also been found to produce some of the heavy unstable particles so far found only in the Cosmic Radiation. This will enable one to investigate in detail the processes responsible for the production of these still rather mysterious particles which appear to decay into neutrons, protons, or π-mesons after living for only one-billionth of a second or less. Cloud chamber photographs illustrating some of the discussed processes will be shown.

Biochemical and Physicochemical Identification of Type II Human Poliomyelitis Viruses

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The development of a procedure for the purification of poliomyelitis virus from infected cotton rat central nervous system tissue in this laboratory has made possible the preparation of Lansing virus (type II) concentrates of unusual purity. The purification method which involves treatment with butanol and enzymes yields virus concentrates with an average specific infectivity 20,000-fold greater than that of the original infected tissue. The recovery of total virus infectivity under these conditions is approximately 50%.

Electron microscopy of these preparations utilizing the micro droplet technic reveals well defined, uniformly spherical particles 28 mμ in diameter plus irregularly shaped, flat masses of amorphous material which constitute approximately 90% of the total mass observed. In contrast parallel preparations of concentrates from uninfected tissue show amorphous material but no 28-mμ particles.

It has been possible to show by correlative studies involving analytical electron microscopy (direct particle counting in micro droplets), ultracentrifugal sedimentation through the barrier of a separation cell, and infectivity measurements that the property of infectivity resides solely in the 28-mμ particle.

By a similar purification method the MEF 1 strain of type II poliomyelitis virus has been obtained in a highly purified state from the nutrient fluid of infected cultures of monkey kidney tissue. Preliminary electron microscopic studies of these virus preparations reveal 28-mμ particles and virtually no amorphous material.

On the Brightness of Lights and the Loudness of Sounds

S. S. Stevens
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Brightness and loudness are subjective attributes of visual and auditory sensation. Both attributes are functions of the energy of the physical stimulus, but they are not simple linear functions of energy. Nor are they proportional to the logarithm of the stimulating intensity, as was first asserted by Fechner, and as has been assumed by many others.

We have studied the relation of brightness and loudness to radiant and acoustic energy by three techniques: bisection, fractionation, and absolute judgment. These techniques require the subject to assess, in different ways, the apparent magnitude of his sensations, and although the results differ in detail they show sufficient agreement to warrant the construction of ratio scales for these subjective magnitudes.

There appears to be a remarkable similarity between the brightness scale and the loudness scale. Over most of the sensible range of intensities, the two scales are roughly a power function of the energy of the stimulus. To a crude first approximation brightness and loudness are proportional to the cube root of the stimulating energy.

Other striking similarities between brightness and loudness are also evident. For example, a sound is masked by noise much as a light is suppressed by glare, and the well-known phenomenon of "auditory recruitment" in which the loudness of a masked sound grows rapidly to normal as its intensity is raised has its analogue in vision. A light that is just invisible in the presence of a glare attains its normal brightness when its intensity is raised to a value equal to that of the glare itself.

The Excluded Volume Effect in Polymer Chains

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The fundamental question implied by the title is whether and how the average dimensions of real flexible long-chain molecules differ from those of the common idealized model based on the theory of random flights. In particular, how do the average dimensions depend on molecular weight of the chain? This question has been hotly debated in recent years. It has acquired considerable glamor because of its theoretical difficulty, but it also is of practical importance for the interpretation of intrinsic viscosity and certain other frequently studied properties of polymer solutions.

The random-flights model predicts that the mean square radius R^2 of the chain is proportional to its molecular weight M. On the basis of both experimental and theoretical studies we have joined the school which asserts that R^2 for real chains increases more rapidly than M, except in certain special solvents. For a series of linear polyvinyl acetate fractions covering the molecular-weight range 0.8 to 3.5 million, our light-scattering measurements show definitely that in butanone solution R^2/M is increasing with M. These results moreover support the simple and useful treatment of intrinsic viscosity proposed by Flory and Fox. Theoretically, one must be content with incomplete answers, but some rather general arguments can be given for the correctness of our conclusion. For example, it can be shown that if R^2/M depends on solvent (as it does experimentally) it must also depend on molecular weight.

Correlation of Rates of Solvolysis

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The solvolysis of an organic compound is its reaction with the solvent in which it is dissolved; this may be water, an alcohol, an acid, an amine, or a mixture. Absolute rates of solvolysis are difficult to correlate because of variations in kinetic energy or entropy terms in the free energy of activation, which do not in general parallel variations in the potential energy terms. The entropy terms appear to be effectively cancelled out if one compares only differences in logarithms of relative rates with the equation

$$\log (k/k^\circ)_A - \log (k/k^\circ)_{A^\circ} = ab$$

where k is the rate constant for solvolysis in any solvent, k° is the same in a standard solvent (80% ethanol-20% water), A refers to any organic chloride or bromide, A° to a standard compound (methyl bromide), a is a constant depending only on the compound, and b is a constant depending only on the solvent.

To test this equation, a total of 124 rate measurements was used, 62 measured in this laboratory and 62 from the chemical literature, representing 15 compounds and 19 solvents. Typical values of a (determined by the method of least squares, defining $a = 0.00$ for methyl bromide and 1.00 for *t*-butyl chloride) are -0.37 for *p*-nitrobenzoyl chloride, $+0.06$ for benzoyl chloride, $+0.18$ for *n*-butyl bromide, $+0.19$ for benzyl chloride, $+0.42$ for *i*-propyl bromide, $+0.78$ for benzhydryl chloride, and $+0.93$ for *t*-butyl bromide. Thus a increases with increasing electron supply to the carbon atom undergoing displacement. Typical values of b (defining $b = 0.00$ for 80% ethanol) are -17.3 for triethylamine, -9.66 for pyridine, -4.78 for aniline, -0.79 for ethanol, $+2.95$ for water, $+0.57$ for acetic acid, and $+4.00$ for formic acid. Thus b increases with both acidity and dielectric constant.

The maximum variation in the observed absolute rate constant k for any one compound over the range of solvents studied is a factor of 2.8×10^6. The maximum and mean errors in absolute k values calculated with the equation are factors of 7.6 and 1.5, respectively.

The Subunits of Myosin

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Myosin, the main contractile protein of muscle, is capable of violent structural changes and enzymic activities. It is composed of two components connected with peptide linkages (*1–4*). These subunits were called light-, and heavy-meromyosin corresponding to smaller and larger molecular weights. A single myosin molecule is made up of four light-meromyosins and two heavy-meromyosins. The important properties of myosin, probably connected with its function, are quantitatively retained by its subunits. The light-meromyosin has a strong tendency to form structures under different conditions and has solubility similar to myosin; the heavy-meromyosin has the total adenosinetriphosphatase activity of the intact myosin molecule and combines with the same amount of actin. The properties of myosin are not only additive and what is lost is contractility. In that respect the whole molecule is more than the sum of its components. It is probable that it is the light-meromyosin where active folding occurs in contraction. The possibility that contraction is a change in the relative position of larger units as opposed to a uniform change in the peptide chain at the amino acid level is discussed. The structure of the light-meromyosin is in accordance to such a theory being composed of about eight units of molecular weight of 6–8000 and still smaller components of two kinds. These are called protomyosins. They are connected mainly end-to-end to form the light-meromyosin.

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A New Evaluation of the *Lucy Ashton* Ship Model and Full Scale Tests

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The British Shipbuilding Research Association has carried out extensive full scale and model resistance tests with the *Lucy Ashton*, the results of which have recently been published in a paper read before the Institution of Naval Architects by Conn, Lackenby, and Walker. A family of six geometrically similar models has been tested and extensive resistance tests have been carried out with the full size ship in an endeavor to supplement William Froude's classical "Greyhound" tests with modern extrapolation data. Although the importance of this B.S.R.A. enterprise can hardly be overestimated, there is a definite lack of model data in the low Reynolds' number field, because there are no facilities available in Great Britain to carry out experiments with 6- and 4-ft ship models with the required accuracy. Such facilities, however, are available at M.I.T. and experiments with two small ship models have been conducted to cover the low Reynolds' number field and to greatly extend the available data for extrapolation from the model family to the full size ship results, which in the formerly available range was lacking in definition. A complete revision of the extended data is presented and the merits of a new and original extrapolation method will be demonstrated.

Effect of Local Action Currents on the Iron Electrode

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The ideal metal electrode for electromotive force measurements is reversible with respect to its own ion species, but no others, and the potential change for a tenfold change of ion activity corresponds exactly to $0.0591/n$ volt at 25° C, where n is the valence of the ion. A few metals approach this behavior, but most metals deviate from the ideal in some degree. For example, an iron electrode is reversible to hydrogen ion in mild acid media, but the potential change for a tenfold change of ion activity can be equal to or less than 0.059/2 volt depending on the electrode and solution. The electrode is peculiarly unaffected by ferrous ions in the same pH range, but is reported to behave in a normally reversible manner in the pH range approaching 7 and above.

This behavior is explained in terms of local-action or corrosion currents operating whenever iron is in contact with an aqueous solution. All metal electrodes to some extent exhibit irreversible effects from this cause. For example, calculated local action currents decrease the reversible potential of cadmium amalgam electrodes, as used for standard cells, in the order of 10^{-9} volt, which is a small effect, but for iron and several other metals the deviation may reach several tenths of a volt. Local action currents for metal electrodes more active than hydrogen in the Electromotive Series always produce a shift of potential in the cathodic direction. The general expression is $E(\text{thermodynamic}) = E(\text{observed}) + f(i)$, where $f(i)$, a function of local action currents, can be calculated from polarization data.

Basic knowledge of the potential behavior of metals is important to various biological and medical techniques, as well as to fundamental electrochemical studies including corrosion of metals, and primary and secondary batteries.

X-Ray Studies of Imperfections in Solids

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The x-ray scattering from a crystal consists of two parts: the sharp Bragg reflections, and the diffuse scattering. The Bragg reflections give the average crystalline structure of the material: information such as the size and shape of the unit cell and the average positions of the atoms within the cell. Any sort of randomness or disorder in the structure produces a diffuse scattering in addition to the sharp Bragg reflections, and it is only from measurements of this diffuse scattering that precise information about the state of disorder can be obtained. The study of the imperfections in real solids is a new and rapidly growing branch of x-ray diffraction analysis. Three types of disorder will be illustrated and discussed.

(a) From the diffuse scattering of x-rays by the temperature vibration of the atoms, it is possible to obtain the elastic spectrum of solids, including the frequency distribution, the velocities of the elastic waves and the dispersion at high frequency.

(b) A disordered binary alloy gives rise to a diffuse scattering due to the random arrangement of the two different kinds of atoms. A Fourier analysis of the diffuse scattering gives directly the short range order parameters of the alloy.

(c) Cold work distortion in a metal produces broadened and displaced peaks in the x-ray diffraction pattern. Fragmentation, random strains and stacking faults all contribute to the observed diffuseness of the pattern. By separating the effects and evaluating each of them, a clear picture of the nature of the cold worked state is beginning to develop.

The Stereochemistry of Deuterium Transfer in Enzymatic Oxidation-Reduction Requiring DPN$^+$

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By the use of deuterium as a tracer, it has been possible partially to elucidate the mechanisms of those oxidation-reduction reactions which require the coenzyme diphosphopyridine nucleotide (DPN$^+$). The reactions investigated in our laboratories, and more recently elsewhere, include those catalyzed by yeast alcohol dehydrogenase, liver alcohol dehydrogenase, lactic dehydrogenase, and a transhydrogenase; in addition, a model system (N-benzyl dihydronicotinamide plus malechite green) has been examined. In all of these reactions, there is a direct transfer of hydrogen (or deuterium) between substrate and coenzyme (or coenzyme model). For example,

$$CH_2CD_2OH + DPN^+ \rightarrow CH_3CDO + DPND + H^+ \quad (1)$$

When DPND (eq. 1) is used to reduce acetaldehyde, the monodeuteroethanol so produced consists of one pure enantiomorph; the other enantiomorph has been prepared by the reduction of deuteroacetaldehyde with ordinary reduced DPN$^+$. Although neither enantiomorph has been obtained in large enough quantity for a polarimetric determination of its specific rotation, the individuality of the stereoisomers has been proved by observing the specific products of their enzymatic reoxidation. Furthermore, it has been possible to perform a stereochemical inversion of one enantiomorph into the other.

The enantiomorphic ethanols can be used both to elucidate the steric requirements of organic chemical reactions around a primary carbon atom, and to investigate the stereospecificity of the direct transfer of deuterium in enzymatic reactions of DPN$^+$.

Carbohydrate Supply and Leaf Development in Sporeling Ferns

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In nature, the sequence of leaves on young ferns proceeds regularly from the initial two-lobed type to the three-lobed and then on to the characteristic pinnate or feathered adult fern leaf. Before any adult leaf appears, 15–20 two-lobed and three-lobed types arise. So regular is this pattern that classical botanical studies on ferns have referred to it as recapitulatory. When grown *in vitro* on a constant, sterile medium containing 2% sucrose, young fern plants follow the same natural sequence. Moreover, when only pieces of the stem apex, 0.25 mm in height, are similarly planted *in vitro*, this same sequence of leaf types still occurs.

A study *in vitro* of the effect of a varying sugar concentration in an otherwise constant medium has shown that profound changes occur in leaf shape. The effective differences in concentration range from 0.1% to 2%; above this no appreciable effect is found. At lower concentration, the first twenty or more leaves are two-lobed; only after such a number does a first three-lobed type develop. On media containing 1% and 2% sucrose, leaves produced on explanted apices have predominantly three or more lobes. At concentrations in between, interesting plants occur with unpredictable ratios of two- and three-lobed leaves.

In leaves, shape is determined by the relative persistence of meristematic activity along the margins and at the apex. Two-lobed leaves, resulting largely from marginal extension and from scarcely any terminal cell divisions, have a heart-shaped appearance, a small photosynthetic surface and little or no root for an absorbing surface. If the concentration is increased, more sugar is absorbed supplementing that obtained by photosynthesis. A direct relation early becomes apparent between the concentration of sugar in the medium and the extent of cell division in the leaf. Marginal meristematic activity, supplemented by apical cell division, forms a three-lobed leaf or a pinnate leaf depending upon the concentration of sugar available.

The results reported here accord with Bullough's findings on the carbohydrate energy relations of cell division in the *in vitro* studies on ectoderm of mouse ears. Certainly it is difficult to see a phylogenetic recapitulatory sequence in it.

Symposium on Neurosecretion at Naples, Italy

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VARIOUS ASPECTS of the problem of neurosecretion were discussed at a symposium held May 11 through 16, 1953, at the Naples Zoological Station. Twenty-eight papers and a number of demonstrations were presented by investigators from Denmark, England, France, Germany, Italy, Japan, Saarland, Sweden, and the United States. There were, in addition, "observers" from different countries who wished to acquaint themselves with recent results in the fast-developing field of neurosecretion.[1]

Surveys on the historical development of the concept of neurosecretion in the vertebrates (E. Scharrer, USA), and the invertebrates in general (B. Scharrer, USA), the crustaceans in particular (Welsh, USA), and the physiology of the hypothalamic neurosecretory system in the vertebrates (Bargmann, Germany) served as introductions to papers on the morphology and physiology of neurosecretory cells in invertebrates and vertebrates. Abstracts of these communications will appear in the *Pubblicazioni della Stazione Zoologica* with references to papers published in extenso in various journals. This report briefly notes only results of general interest as they evolved from the discussions.

Neurosecretory cells represent a distinct cell type. They do not appear haphazardly in the nervous system, but form definite groups which are always found in a location that is characteristic of a given type of animal. Their products may be stained by several techniques, of which the chrome hematoxylin phloxin method of Gomori is, as Bargmann showed, the most selective. Of particular interest were the observations demonstrating the transport of the neurosecretory material along the axons of the cells that elaborate it. The original experiment of Hild, who showed in the frog that the neurosecretory material accumulates proximal to the site of an interruption in the neurosecretory pathway, was repeated by B. Scharrer in the insect *Leucophaea*, by Stutinsky (France) in the eel and the rat, by Mazzi (Italy) in the newt, by Benoit and Assenmacher (France) in the duck, by Zetler and Hild (Germany) and Scharrer and Wittenstein (USA) in the dog, always with the same result. The demonstration by E. Thomsen (Denmark) of the accumulation of neurosecretory granules proximal to the site of a ligation of a nerve carrying the material in the fly, *Calliphora*, was particularly elegant. Finally, Carlisle (England) reported the actual observation of movement of neurosecretory material in living nerve fibers of crustaceans by means of phase-contrast microscopy. Bounhiol, Arvy, and Gabe (France) were able to correlate different phases of the proximo-distal transport of the neurosecretory material in the silkworm with a sequence of events in postembryonic development.

The development and maturation of neurosecretory systems constitutes a field still to be explored. Only one communication (Wingstrand, Sweden) dealt with this aspect, in the chick embryo. Strictly speaking, the neurohypophysis is not an endocrine organ; the hormones extractable from it are produced by neurosecretory cells in the hypothalamus and are merely stored in the posterior lobe (Zetler and Hild). The comparative anatomy of the neurohypophysis is, therefore, of renewed interest (Hanström, Sweden). Similarly, the corpora cardiaca of the insects serve as storage organs for the neurosecretory substance derived from the brain (B. Scharrer). In this case there is cytological (Arvy and Gabe; M. Thomsen, Denmark) as well as experimental (Wigglesworth, England) evidence to indicate an additional secretory activity and a concomitant endocrine function of the tissue of the corpora cardiaca in its own right. The role of the sinus gland and related structures (Knowles, England) of the crustaceans is in many respects analogous to that of the neurohypophysis and the corpora cardiaca. Bliss (USA) and Enami (Japan) showed that fiber bundles from a number of neurosecretory cell groups of the crustacean central nervous system end in the sinus gland, in which the neurosecretory substance is stored. Removal of the neurohypophysis (Stutinsky) or of the sinus gland (Bliss, Enami) leads to essentially the same result, i.e., as new nerve terminals regenerate from the cut ends of the nerves, neurosecretory material is again seen to accumulate at the nerve endings. Interesting observations of the appearance of neurosecretory systems under different experimental conditions were reported by Azzali (Italy) in bats, Mazzi in amphibians, Possompès (France), and Grandori (Italy) in *Diptera*, Dupont-Raabe (France) in phasmids, etc.

Throughout the symposium a highly satisfactory correlation was achieved between the results obtained by morphological and by physiological methods; physiological data alone (Koller, Saarland) seem insufficient to establish a neurosecretory process. Equally important was the good agreement of observations made in invertebrates and vertebrates; the general conclusions were, therefore, not based on isolated

[1] For reviews see: E. Scharrer and B. Scharrer, *Biol. Revs.*, **12**, 185–216 (1937); *Research Pubs. Assoc. Research Nervous Mental Disease*, **20**, 170–194 (1940); *Physical Revs.*, **25**, 171–181 (1945); In W. von Möllendorff and W. Bargmann, Eds., *Handbuch d. mikrosk. Anat. d. Menschen*, VI/5, Heidelberg: Springer (in press); In G. Pincus, Ed., *Recent Progress in Hormone Research*, IX, New York: Academic Press (in press).

cases, but concerned fundamental phenomena common to all animals in which neurosecretion has been studied.

Stahl and Seite (France), DeLerma (Italy), Enami, and M. Thomsen described various aspects of the cytology and cytochemistry of neurosecretory cells in different animals. The view, advanced some years ago, that neurosecretory material is formed in the cell at the expense of basophil constituents has not been refuted by newer observations, but has not been definitely proved. Comparatively little use has as yet been made of methods permitting the observation of living neurosecretory cells. Passano (USA) and Carlisle demonstrated the suitability of phase microscopy, E. Thomsen that of darkfield illumination. The physical and chemical properties of the substances produced by neurosecretory cells are under investigation in various laboratories, but the results do not yet permit generally applicable conclusions.

The question was often raised: In which way is the study of neurosecretion likely to proceed? One of the major problems concerns the mechanism by which the hypothalamus controls the adenohypophysis. Benoit and Assenmacher presented evidence obtained in birds that neurosecretion may play a role, but this was contested by Zuckerman (England) on the basis of observations in mammals. In various animals there are additional groups of secretory neurons the investigation of which may lead to the discovery of new hormones. Indeed, Waterman (USA) and Enami added the lateral white body ("rudimentary eye") of the xiphosuran *Tachypleus* to the neurosecretory organs whose functions are still to be explored.

The success of the symposium was due to the cooperation and hospitality of the Stazione Zoologica, now again a center of biological research in Europe, and the financial assistance rendered to individual participants by government agencies and private foundations of the countries represented at the symposium.

The next meeting on neurosecretion will be held at the University of Lund, Sweden, at the invitation of Professor Bertil Hanström.

Friends of Pleistocene Glacial Geology Field Meeting, Ayer Quadrangle, Massachusetts

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THE ANNUAL FIELD MEETING of the Friends of Pleistocene Glacial Geology was held on Saturday and Sunday, May 23 and 24, in the Ayer, Massachusetts, quadrangle and adjacent areas. About 75 geologists were present. The meeting was under the leadership of L. W. Currier, assisted by J. H. Hartshorn and others of the staff of the Massachusetts cooperative geologic program, of the U.S. Geological Survey.

The recently published surficial geology map of Ayer quadrangle, by R. H. Jahns, was used as a background for the meeting. This map is on a scale of 2 inches to a mile and shows, in great detail, the various glacial and Recent landforms of the area, and bedrock exposures. A special feature is a smaller colored map (scale 1:48,000) that shows numerous outwash sequences in relative chronological order, and that illustrates a new method of field mapping and geologic cartography in New England, as devised by Jahns. The principal object of the field trip was to study the outwash sequences and the basis for separation of the outwash features into the various sequences. The first day was spent in the eastern half of Ayer quadrangle. The second day was spent in the northeastern quarter of Hudson quadrangle and the northwestern quarter of Maynard quadrangle, both mapped recently by W. R. Hansen and the maps now in preparation for publication.

Identifiable end moraines are conspicuously absent in southern New England except on Cape Cod, around Buzzards Bay, and in the coastal part of southern Rhode Island and southeastern Connecticut. The late Pleistocene (Wisconsin) deglaciation appears to have been characterized by the stagnation and disintegration of the frontal zone of the ice sheet, leaving blocks and essentially motionless tongues of ice in the valleys. Meltwater deposited impressively great quantities of outwash materials around and within the blocks as kame terraces, kame plains, and ice-channel fillings, and along the valleys as pitted outwash plains. The whole assemblage might be broadly considered as making up long valley trains in which ice-content forms are particularly abundant. Locally deltaic deposits (deltas and kame deltas) and lake bottom deposits were formed in small lakes of relatively short duration, where valley outlets were blocked by ice, glacial deposits, or bedrock; subsequent melting of ice barriers within valleys and lowering of other barriers by erosion permitted draining of these ponded areas through various and successive outlet channels.

For the most part present swamp areas were the sites of remnant ice blocks that persisted while outwash gravel and sand were being deposited around and on them, or in channels across them. Some swamps, generally the smaller ones, however, occupy depressions in glacial deposits. Till covers the upland areas and

doubtless underlies much of the "valley train" outwash deposits; except for the drumlins, which are numerous in parts of the region, the till sheet is comparatively thin.

Two kinds of till are recognizable. The stratigraphically lower till is hard, compact, and brownish gray in color; the upper till is mostly light gray, loose, and granular. In places both tills display thin oxidation zones. It is controversial, however, whether the tills represent two distinct advances of the ice, or subglacial and englacial (or supraglacial) tills of a single advance. No undoubted soil, loess, or lake deposits have been found between the tills in their region. On the other hand, wherever seen together in an exposure, the loose light-gray till overlies the compact brownish-gray till, and in numerous places fragments of the lower till have been found in the upper till. Although it seems unquestionable, from a consideration of the Pleistocene stratigraphy of Long Island, Cape Cod, and the islands south of the Cape, that earlier ice sheets crossed the region, no tills of undoubted earlier Pleistocene age have yet been identified in the region to the north.

The delineation of individual outwash sequences within valleys was based upon a correlation of altitudes of outwash forms to conform with a systematic gradient of deposition, continuity of deposits, and gradation of materials. Thus, a single sequence is characterized by relatively high kame terraces at the head which merge into lower kame terraces and finally into pitted outwash plains at the lower ends; along the course, but particularly in the central and upper parts, ice-channel deposits conform roughly in altitude with the lateral kame terraces. Deposition of a sequence ceased when, within a valley, a lower outlet was opened by shrinking of ice blocks, and the subsequent outwash deposits then became graded to a lower and different local base-level to form a new sequence. The base-level of a given sequence would thus be determined by a bedrock or till threshold, a temporary lake, or the base-level of an unpitted outwash plain. Several sequences, therefore, may be found in a single major valley, and they would be distinguished chiefly by several distinct levels of kame terraces, each of which could be coordinated into a systematic depositional profile.

That deglaciation proceeded by progressive disintegration and retreat of a frontal "stagnation zone" is considered to be supported by (1) the absence of identifiable end moraines, (2) the abundance, variety, and distribution of outwash forms with ice-contact boundaries, and (3) integration and correlation of multiple outwash sequences in major valleys. The "stagnation zone" doubtless varied in width in different parts of the region. The minimum width at any time would be measured by the distance between the lowest pitted outwash plain and the highest terraces of the sequence. For the Ayer quadrangle, Jahns estimates the minimum width to have been about three miles, but elsewhere the width may have been considerably greater.

Doubtless several conditions favored the formation of a frontal stagnation zone instead of a simple integrated ice front during the retreatal stage. Probably the most important factor in causing stagnation and disintegration was the topography of the region over which the ice rode. Much of southern New England had, in preglacial times, reached an early old-age state of development, but rejuvenation by at least two uplifts had deepened the valleys markedly. As the ice sheet thinned by ablation, the uncovering of divides left thin tongues or masses of ice within the valleys and in these motion ceased. Continued wastage, and broadening and flattening of the ablation surface, possibly by relatively rapid increase of atmospheric temperature, would inevitably result in disintegration of the ice into smaller blocks. It may well have been true that the last ice sheet was comparatively thin in these latitudes so that end moraines were scant or wanting even in the initial stage of recession. Had the region been one of less relief, even with a thin ice sheet end moraines might have been expected to form at first and to be followed by stagnation.

The conditions were somewhat different from those north and northwest of the Boston Basin, for the land mass was less dissected and the general relief was less, especially in the coastal plain area (Plymouth-Buzzards Bay-Cape Cod). Here the ice sheet could retain a mobile condition for a longer time. It is suggested that this, at least in part, accounts for the presence of end moraines and kame moraines in this southeastern area, in contrast with the glacial forms found in the areas to the north, particularly west of north of the Boston Basin, where outwash sequences seem to be more sharply defined. Indeed the area just south and southwest of the basin seems to be transitional between these two areas. From the general vicinity of Plymouth, for instance, the bedrock surface declines southeasterly below the present sea level, and it lies deeply buried beneath the entire Cape Cod region. Thus, some of the general conditions and interpretations relating to wasting and stagnation described by Flint for Connecticut and eastern New England appear to be well supported by features in the Ayer quadrangle and adjacent areas.

Vitamin B_{12} Conference

Robert A. Harte and Bacon F. Chow

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A SYMPOSIUM on the current status of research on vitamin B_{12} was held at the School of Hygiene and Public Health of The Johns Hopkins University on June 5 and 6 with Bacon F. Chow as chairman. Sixty scientists, representing government, university, hospital, and industrial research laboratories, as well as the American Medical Association and the National Vitamin Foundation, attended. Twenty of these presented summaries of their current work and led discussions of hypotheses that will, it is hoped, serve as springboards for future researches.

More and more, nutritionists have come to recognize the vital importance of the interrelationships of all the elements of diet. It is no longer sufficient to deal with gross effects such as weight gain, reproduction, or even nitrogen balance, if the role of an essential nutrient, such as vitamin B_{12}, is to be appreciated. Investigations of a substance so protean in character as B_{12} must call on scientists with special interests in fields as diverse as nuclear physics, hematology, enzymology, endocrinology, and nutrition, as well as internal medicine and ophthalmology.

The subject matter of the conference may be divided among the major headings Metabolic Roles, Hematopoiesis, and Renal Function. The original concept that vitamin B_{12} is identical with Castle's extrinsic factor remains unchanged, but current research tends to extend our ideas of its general importance far beyond this limited role. The availability of B_{12} tagged with radioactive Co^{60} has facilitated studies of its absorption and excretion pathways and has pinpointed its loci of storage in the host following oral or parenteral administration. The promise of future availability of tagged vitamin with even higher specific activity, and improvements in counting techniques, as with the scintillation counter, will permit extension of these studies at true physiologic levels. This will go far toward eliminating the errors almost inevitably introduced in extrapolating conclusions drawn from data obtained under nonphysiologic conditions.

Both *in vitro* and *in vivo* experiments were reported which suggest that B_{12} plays an important role in the synthesis of nucleic acids and in the metabolic pathways of such compounds as glycine, serine, methionine, and choline. Growth studies, although necessarily of limited specificity, emphasize the importance of adequate supplies of B_{12} in the metabolism of carbohydrate and fat, including not only the conversion of carbohydrates (and the carbon skeletons of amino acids) to fat but also the metabolism of fat itself.

The presence or absence of adequate amounts of dietary B_{12} has significant effects in modifying the concentration of sulfhydryl-containing compounds of physiologic importance, among which would be included glutathione and coenzyme A. If the hypothesis that, in the absence of sufficient B_{12}, the reduction of the —S—S— form of coenzyme A to the —SH | form fails to proceed can be substantiated, then the role of B_{12} in fat metabolism becomes clearer. This intriguing thesis finds support in the gross observation of fat accumulation in chicks and rats subsisting under conditions of chronic B_{12} deprivation.

There seems to be no evidence to indicate that B_{12} plays a significant role in overall nitrogen balance in the rat. Both paired-feeding and forced-feeding experiments have shown substantially identical nitrogen balances to obtain, regardless of the presence or absence of vitamin in the diet. There are reports of increases in nitrogen balance in rabbits under the influence of the vitamin, but possibly these observations reflect increased food intake and not changes in the efficiency of utilization of dietary protein.

These and other reported clues to the varied metabolic transformations involving B_{12} await clarification and extension through detailed studies of isolated enzyme systems. Despite their significant implications, major interest continues to focus on the role of B_{12} in the therapy of Addisonian (pernicious) anemia and on the interrelationships between the vitamin and Castle's intrinsic factor.

Pernicious anemia must, in the light of present knowledge, be regarded as the result of a tissue deficiency of B_{12} rather than a dietary lack. The failure of dietary B_{12} to reach the tissues appears to reflect a hypofunctioning of certain secretory cells in the gastrointestinal tract, leading to a deficiency, of greater or less severity, of intrinsic factor. This concept, which stems from Castle's postulation of intrinsic factor in 1929, has resulted in wide acceptance of the thesis that successful oral therapy of Addisonian anemia calls for an adequate exogenous source of intrinsic factor. Since that time, much research effort, at best, only partially successful, has been concerned with the isolation and characterization of intrinsic factor.

This background of almost a quarter century underlines the significance of clinical studies reported by C. Lockard Conley and his associates. They have observed that pernicious anemia patients in relapse could be brought into remission and maintained without an

exogenous source of intrinsic factor by the oral administration of large doses of vitamin B_{12}. Using a regimen that calls for initial oral administration of a single 5000-μg dose followed by 1000-μg doses once each week, more than 15 patients in relapse have been brought to remission and maintained symptom-free for periods up to 2½ yr; over 100 patients have been followed for at least a year. This schedule probably does not represent minimal therapy, but is safe in that there have been no failures. When the same total amount of B_{12} was given in divided doses, the clinical results were not as good. The quantities of B_{12} involved appear large when compared with the generally accepted idea that the usual daily intake in the dietary of clinically healthy individuals is only 1–2 μg, but they are still small in absolute amount. The extraordinary potency of B_{12} as an essential factor in erythropoiesis is thus again affirmed.

If continued observation of these patients over an additional period of years confirms the finding that the recommended regimen will maintain pernicious anemia patients asymptomatic, then it would appear that intrinsic factor plays only an accessory role and that the mass-action effects of large enough doses of B_{12} readily replace it in the therapy of the disease. Until studies of this character, where patients are under continuing scrutiny of competent investigators for long periods of time, establish the adequacy of the proposed regimen in avoiding the insidious complications encountered under therapy that corrects only the hematologic picture, treatment of choice for Addisonian anemia remains the periodic injection of crystalline vitamin B_{12}. Nevertheless, these reports emphasize and support the thesis that the fraction of orally ingested B_{12} absorbed is capable of fulfilling the important physiologic functions of the vitamin.

These and other reports to the conference raise the overall question of the possible existence of other manifestations of B_{12} deficiency. There was extended discussion of the existence, in varying degrees, of B_{12} deficiencies associated with conditions other than pernicious anemia. Data were presented that indicate highly significant variations in the degree of tissue saturation with respect to B_{12} in diabetics with and without retinopathy, compared with each other and with clinically healthy individuals of the same age and sex. These variations in saturation states in the two types of diabetics are associated with striking changes in the excretory patterns for adrenocortical hormones, suggesting some relationship between B_{12} and these steroids.

Variation in the extent of tissue saturation with respect to B_{12} appears also to be related to age among clinically healthy subjects. In this connection one is reminded of the diminishing secretion of acid from the parietal cells of the gastric mucosa among the aged. The observed B_{12} saturation differences thus may be explained as reflecting possible progressive changes in absorptive mechanisms with increasing age.

In part at least, these results with diabetics and amoung various age groups, as well as other data comparing populations maintained over long periods of time on strikingly different dietaries (Mexicans on mainly vegetable diets compared with Americans on highly nutritious diets), find partial explanation in known biochemical facts. Full elucidation of the extent and gravity of B_{12} deficiency states among people not suffering from pernicious anemia must await further surveys and additional clinical and biochemical studies.

From studies on laboratory animals, strong indications have emerged to suggest that the kidney is a focal point in the metabolism of B_{12}. By far the largest portion of an administered dose is concentrated in the kidney and remains detectable in that organ over long periods of time. Experiments with humans indicate that, while much of administered B_{12} is promptly excreted, the quantity retained is directly correlated with the administered dose. Tissue saturation can be achieved, therefore, only through adequate dosage.

Although the scope of the conference was limited to the subjects discussed above, no summary of the varied roles of B_{12} would be complete without mention of its effects on growth in children. Several papers in the literature report studies in this direction. Superficially, the findings may appear to disagree. Nevertheless, no studies meeting the criteria laid down in one of the first reports have failed to support the thesis that oral supplementation with B_{12} has a beneficial effect on child growth. These criteria are: (*a*) previous history of nutritional stress, including B_{12} deficiency; (*b*) ad libitum access to food during the study period; and (*c*) adequate nutrients and calorie distribution in the diets offered.

In addition to providing an up-to-date summary of important researches in progress in this field as well as the current thinking of some of its leading workers, the meeting served to emphasize once more the value of bringing together outstanding students of the varied disciplines that contribute to the progress of such complex investigations.

News and Notes

Science News

In line with the policy laid down by Charles E. Wilson, Secretary of Defense, to favor private industrial rather than governmental management and direction of research and development, a change of much importance in the relation of government to science has recently been announced. **Camp Detrick,** at Frederick, Md., center of the Army Chemical Corps research in biological warfare, is to be transferred from military and civil service management to the management, under contract, of the **Mathieson Chemical Corporation.** Mathieson, which has recently acquired control of the old pharmaceutical house of Squibb and Sons, including Squibb's well-known Institute for Medical Research, was clearly better qualified to direct such work than any of the other firms bidding for the contract.

According to Donald A. Quarles, Assistant Secretary of Defense for Research and Development, the reasons for turning from Army to private management are that (1) the private contractor offers industrial management not available to the Army, (2) the project will be given continuity, and (3) interservice rivalry can be eliminated. It is rather hard to see how the last two of these reasons apply in the present case. On the other hand, the notion that Mathieson would operate the Army's germ warfare facilities in the same way that the Chrysler Corporation runs the Army's tank arsenal in Detroit, as one newspaper reports the Army officials to have said, is on the side of the naive. Would anyone, scientist or not, suppose that the production of basic research in bacteriological science, which is the chief activity at Camp Detrick, is a production problem like the production of tanks? Let it be once more emphasized that the fundamental condition of a good output in basic scientific research is the quality of the scientists employed. If morale declines, some men will go elsewhere and others will lack that zest and drive which are so essential in the laboratory.

For this reason the present measure must be questioned—and not because of the ultimate inadvisability of industrial management of government research, although that too may be debatable. The prime criticism in the present instance is of the approach of the Army officials to the matter, which was conducted in such secrecy that the men most concerned, the scientists working at Camp Detrick, first learned about the transfer from the news releases. As a consequence certain scientists who will be difficult to replace have resigned—scientists who do not like to go to bed under civil service and awake the next morning under private industrial management without being forewarned. Morale has been shaken in this group of scientists, just as it was shaken earlier in the year at the National Bureau of Standards; and the loss of even a few crucial men engaged in key problems may be irreparable. The likely, but unpredictable, extension of industrial management to other branches of the Army and the federal government has already led to unrest among scientists at other centers.

The work of Mathieson Chemical Corporation in managing Camp Detrick will be supervised by Major General Egbert F. Bullene, Chief of the Army Chemical Corps. Dr. H. I. Stubblefield, present administrative chief of Camp Detrick, will continue to serve as a liaison officer between the Pentagon and the actual research work at the laboratories. Somewhat over 100 existing subcontracts for research carried on in universities and commercial laboratories to further and to supplement the investigations at Camp Detrick have also been transferred to Mathieson.

The British Admiralty has announced the removal of the **Royal Observatory** from Greenwich to Hurstmonceux, a 15th century castle in Sussex. The new location will be long. 20′ 25″ E, and lat. 36′ 30″ south of the Greenwich parallel, or approximately 60 miles southeast of the former site. In January, when the 7-year transfer is complete, it will become necessary to subtract about a minute and a quarter from the time in order to retain Greenwich as the zero meridian. The industrial atmosphere of London—the fog, smoke, and illumination in the night sky—has forced the move.

The U.S. Department of Agriculture has announced publication of the *1953 Yearbook of Agriculture: Plant Diseases.* The new *Yearbook* describes the causes and control of hundreds of diseases of crop plants. Included is a 32-page section of color photographs designed to help readers identify many of the more important diseases.

In his foreword, Secretary of Agriculture Ezra Taft Benson says: "To me the most startling aspect of plant diseases is that they cost us an estimated three billion dollars a year. . . . The tragic aspect is that much of the loss is a waste that can be prevented."

Scientists in the News

Rubert S. Anderson, formerly professor of physiology and pharmacology at the University of South Dakota School of Medicine, has accepted an appointment to the medical laboratory staff, Army Chemical Center, Md.

Robert C. Angell, Professor of Sociology at the University of Michigan, has been elected President of the International Sociological Association for the 1953–56 term.

Richard T. Arnold has been appointed Head of the Chemistry Department at the University of Minnesota.

He succeeds **Lloyd H. Reyerson,** who remains Assistant Dean of the Institute of Technology in charge of the School of Chemistry. The School of Chemistry consists of the departments of chemistry and chemical engineering.

At the University of Dayton, **Rev. William Bellmer,** Professor of Mathematics and Head of the Department of Mathematics, has been named Associate Dean of Science.

The California Institute of Technology has appointed 3 scientists to serve as visiting professors during the current academic year. **L. G. Berry,** Associate Professor of Mineralogy at Queen's University, Kingston, Ontario, and **George E. Hall,** Associate Professor of Chemistry at Mount Holyoke College, are visiting professors of chemistry; **Edmund Schulman,** Associate Professor of Dendrochronology at the University of Arizona, is a visiting professor of dendrochronology.

The Franklin Institute has awarded an Elliott Cresson Medal to **William Blum,** former Chief of the Electrodeposition Section of the National Bureau of Standards, "in recognition of his long continued and unusually meritorious work in creating a modern scientific basis for the electrodeposition of metals, and for his development of useful processes in that field."

John O'M. Bockis, Lecturer in the Department of Inorganic and Physical Chemistry at the Imperial College of Science and Technology, London, England, has been appointed Visiting Professor of Chemistry for the academic year 1953–54 at the University of Pennsylvania.

The Academy of Natural Sciences of Philadelphia has given the 1953 Hayden Memorial Geological Award, a gold medal, to **Norman Levi Bowen,** petrologist and geophysicist of the Carnegie Institution of Washington. The medal is presented every three years "as a reward for the best publication, exploration, discovery or research in the science of geology and paleontology, or in such particular branches thereof as may be designated." Dr. Bowen was cited as "a leader in physico-chemical research in petrology, introducing systematic, quantitative, experimental work on problems of origins of minerals and igneous rocks." His publication, *The Evolution of Igneous Rocks,* was referred to as a classic.

At Middlebury College, Vt., **John G. Bowker,** Head of the Mathematics Department, has been named Dean of the Faculty; **Grant H. Harnest** is the new Head of the Chemistry Department; and **John A. Valentine, Jr.,** has become Head of the Psychology and Education Department.

The resignation of **Marion W. Boyer** as General Manager for the Atomic Energy Commission and the appointment of **Maj. Gen. K. D. Nichols,** wartime district engineer for the Manhattan District, as his successor have been announced. The change was effective Nov. 1, the termination date of Mr. Boyer's 3-year term.

G. W. Brindley of the Physics Department, University of Leeds, England, has joined the staff of the Pennsylvania State College as research professor of mineral sciences.

Marjorie L. Browne of North Carolina College has been appointed Chairman of the Department of Mathematics.

The National Science Foundation has announced the following new staff appointments:

Leon W. Cohen, formerly of Queens College, to be Program Director for Mathematical Sciences in the Mathematical, Physical and Engineering Sciences Division.

Hubert B. Goodrich of Wesleyan University, to be Program Director for Developmental, Environmental and Systematic Biology in the Division of Biological and Medical Sciences.

Thomas J. Mills, from the U.S. Bureau of the Budget, to be Program Director for Scientific Manpower in the Division of Scientific Personnel and Education.

Adriance Foster, Professor of Botany on the Berkeley campus of the University of California, has been elected President of the Botanical Society of America.

Edward C. Fuller, former professor of chemistry and director of the area of natural sciences and mathematics at Champlain College of the State University of New York, has been appointed Professor of Chemistry and Chairman of the Department at Beloit College.

Alex E. S. Green, formerly of the University of Cincinnati, has become Associate Professor of Physics at Florida State University.

Earl L. Green of Ohio State University, and **W. R. Boss** of Syracuse University, have each been granted a leave of absence in order to work with the Atomic Energy Commission's Division of Biology and Medicine. Dr. Green, geneticist, replaces **Harold H. Plough,** who has returned to his academic post at Amherst College, and Dr. Boss replaces **Karl M. Wilbur,** physiologist from Duke University.

Milton Joffe, formerly associated with the Hanford Works of the General Electric Company, is serving as a physiologist in the Field Toxicology Branch of the Army Chemical Center, Md.

Geoffrey Keller, who has been serving in an acting capacity, has been named Director of the Perkins Observatory, Delaware, Ohio. The observatory is operated jointly by Ohio Wesleyan and Ohio State universities.

Charles D. Kochakian, formerly Associate Director, has been appointed Co-ordinator of Research of the Oklahoma Medical Research Foundation to replace **Edward C. Reifenstein, Jr.,** who resigned as Director of

Research on June 30. **Stewart G. Wolf, Jr.**, Professor and Head of the Department of Medicine, University of Oklahoma Medical School, has assumed, in addition to his regular duties, the responsibilities of Supervisor of Clinical Activities in the Oklahoma Medical Research Foundation Hospital.

Joseph M. Lambert, former research physicist and group leader in applied physics at the General Research Laboratory of the General Aniline & Film Corporation, is now a research fellow at the Mellon Institute.

Nolan D. C. Lewis, Director of the New York State Psychiatric Institute and Professor of Psychiatry at Columbia University, has been appointed Director of the newly organized research division of the New Jersey Neuro-Psychiatric Institute at Skillman.

The Franklin Institute has awarded **David G. C. Luck** of the RCA Laboratories the Stuart Ballantine Medal "for his invention of the Omnidirectional Radio Range, an essential element in present day air traffic control."

Warren L. McCabe, chemical engineer, has resigned as Vice President and Director of Research at the Flintkote Company, Whippany, N.J., to accept deanship of the college of the Polytechnic Institute of Brooklyn. He succeeds **Erich Hausmann**, who has retired after 45 years on the institute's faculty.

Dan McLachlan, Jr., and **Bruno J. Zwolinski**, former professors at the University of Utah, have joined the physics staff of the Stanford Research Institute to aid in a research program on explosives and the effects of shock waves upon steel.

The American Hospital Association has given **Basil C. MacLean**, Director of the Strong Memorial–Rochester Municipal Hospitals, Rochester, N.Y., its Award of Merit, the highest award in the hospital field.

W. H. Pell, formerly Head of the Department of Mathematics at the University of Kentucky, has been appointed to an associate professorship in the Graduate Division of Applied Mathematics, Brown University.

Maurice C. Pincoffs, Professor of Medicine at the University of Maryland School of Medicine, has been appointed to serve on the National Advisory Arthritis and Metabolic Diseases Council. It is on the recommendation of this Council that the Surgeon General awards research grants.

Harry Polachek of the Naval Ordnance Laboratory, Silver Spring, Md., has accepted a position as Head of the Applied Mathematics Laboratory, David Taylor Model Basin, Washington, D.C.

James C. Sargent has resigned membership on the Health Resources Advisory (Rusk) Committee; his successor is **Francis J. Braceland**, psychiatrist, of Hartford, Conn. Dr. Sargent is continuing to serve H.R.A.C. as a consultant.

W. C. Schroeder, an authority on synthetic liquid fuels, has resigned as Assistant Director of the U.S. Bureau of Mines. He will become a professor of chemical engineering at the University of Maryland under a contract which will permit him to serve as consultant to industrial firms.

Isidore Snapper, formerly Director of Medical Education at Cook County Hospital, Chicago, has been appointed Director of Medical Education at Beth-El Hospital, Brooklyn. Dr. Snapper's major interests lie in the biochemical and clinical aspects of liver, bone, fungus, and metabolic diseases.

At the 5th annual meeting of the American Association of Clinical Chemists, **Michael Somogyi**, biochemist, and a pioneer in the study of sugar metabolism, received the 1953 Ernst Bischoff Award. Dr. Somogyi, who was born in Austria in 1883 and received his Ph.D. in Hungary, has been in charge of the research and chemical laboratories at the Jewish Hospital, St. Louis, since 1926. He has introduced many of the methods now standard in clinical chemistry and has been widely published on such subjects as diastases, the physiology of insulin action, clinical studies of diabetes, and analytical methods.

A. F. Stevenson, formerly of the University of Toronto, has been appointed Associate Professor of Mathematics and Physics at Wayne University.

Maria Telkes, for 14 years a research associate at the Massachusetts Institute of Technology, has been appointed a research associate in the Research Division, College of Engineering, New York University. Dr. Telkes is noted for achievements in solar energy utilization—she designed the "sun-heated" house in Dover, Mass.—and in the conversion of sea water to drinking water.

Atha Thomas, Associate Clinical Professor and Chief of Orthopedic Surgery at the University of Colorado Medical School, has been made Chief of the Orthopedic Service at National Jewish Hospital, Denver.

H. E. Wiedemann of St. Louis, consulting chemist and former national president of Alpha Chi Sigma, has completed 50 years of service in his profession. On Nov. 16 a banquet in his honor is being given by the St. Louis Professional Chapter of Alpha Chi Sigma.

Harold G. Wilm, Chief of the Division of Forest and Range Influences, U.S. Forest Service, has resigned to become Associate Dean of the New York State College of Forestry at Syracuse.

Horatio C. Wood, Emeritus Professor of Physiology and Pharmacology, Philadelphia College of Pharmacy and Science, has retired from active service after 32 years of teaching.

Education

Architectural plans for the **Albert Einstein College of Medicine** of Yeshiva University, the first new medical school to be established in New York City since 1898, have recently been made public. The College will be the initial unit of a comprehensive $25,000,000 medical teaching center to include colleges of dentistry, nursing, public health, and postgraduate studies. The College, named for Dr. Einstein on his 74th birthday earlier this year, will be constructed on a 16-acre site in the Bronx. It will adjoin the new 1400-bed Bronx Municipal Hospital Center, which will be an affiliate and which will serve as the clinical teaching center.

The faculty and students will be selected on the basis of scholarship and ability alone, without regard to race, creed, or color. The first class, to consist of 100 freshmen, will be admitted in the fall of 1955. Seven hundred applications for admission already have been received. A third of these came from New York and a half from areas west of Chicago. Three hundred applications for teaching posts are also under consideration. The college plans to employ 300 full-time faculty members and 400 physicians on a part-time basis. A ratio of six students for each faculty member will be maintained.

The Phillips Foundation of New York has given **Cornell University** $1,200,000 for a new engineering center to house the Cornell School of Electrical Engineering. Construction is expected to begin this year.

Under a cooperative **work-in-industry program,** the Mackintosh-Hemphill Company, steel mill roll and machinery manufacturer, is helping two of its employees to attend the University of Pittsburgh's School of Engineering and Mines. The student employees will go to school 10 hours each week and work 30 hours at various jobs in the company's plants. At the end of three years they will be eligible for certificates of engineering fundamentals from the university, and then can either discontinue their schooling or can go on to earn their B.S. degrees in a particular branch of engineering—mechanical, metallurgical, civil, or electrical.

Grants and Fellowships

The medical school of the **American University of Beirut** has embarked on a five-year improvement plan, partly financed by the Rockefeller Foundation. The Foundation has agreed to contribute $500,000 to the expansion of the medical teaching program if the university can obtain $1,000,000 from other sources. Stephen B. L. Penrose, who is President of the university and who has recently returned from a fund-raising trip to the United States, has announced that he already holds pledges for $600,000. The Rockefeller Foundation has agreed to release $100,000 of its grant for each $200,000 in cash raised by the university.

In 1938 the Foundation granted $1,000,000 to the university for construction of a new hospital building if the university could match it with $500,000—the converse of the current arrangement. Construction of the new hospital wing was deferred during World War II and is now being completed.

A grant of $3200 has been awarded **The George Washington University** by the Research Corporation for research relating to the way in which certain inorganic chemical reactions take place. The study will be under the direction of Theodore P. Perros, Assistant Professor of Chemistry.

The Biology Department of the **Illinois Institute of Technology** has been awarded $30,000 by the Toni Division of the Gillette Company to support work on endocrinology, tumors, and keratin, the prominent protein in hair and skin. Leon L. Gershbein, Associate Professor of Biochemistry, will be principal investigator. Boguslaw Krotoczynski, Research Associate, will work with him.

The **School of Mathematics of the Institute for Advanced Study** will allocate a small number of grants-in-aid to gifted young mathematicians and mathematical physicists to enable them to study and do research work at Princeton during the academic year 1954–1955. Candidates must have given evidence of ability in research at least comparable to that expected for the degree of Doctor of Philosophy. Blanks for application may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, N.J., and *are returnable by January 1, 1954.*

The **United Cerebral Palsy Association** has awarded three grants to the **University of Illinois** to support research and teaching programs in the College of Medicine. The awards are as follows:

$19,313 for research in cerebral palsy, with emphasis on disability evaluation and the application of physiological techniques for the facilitation of motor learning. Chief investigator, F. A. Hellebrandt, Dept. of Physical Medicine and Rehabilitation.

$10,000 (renewal) for the investigation of the neuropharmacological aspects of cerebral palsy. Chief investigator, Klaus R. Unna, Dept. of Pharmacology.

$3600 for a special study of the treatment of cerebral palsy designed to provide basic instruction in its clinical administration. Chief investigator, Beatrice D. Wade, Dept. of Occupational Therapy.

The American Cyanamid Company (Calco Chemical Division) and the Lipotropic Research Fund of New York City have awarded W. E. Cornatzer of the **University of North Dakota Medical School** $4250 to study the comparative lipotropic effects of choline, betaine, and inositol in experimental liver disease.

The **Atomic Energy Commission** recently awarded 37 unclassified physical research contracts:

University of Arkansas. R. R. Edwards. Chemical effects of nuclear transformation, $48,553.

University of Arkansas. R. R. Edwards. Investigation of the radioactivity of thermal waters and its relationship to the geology and geochemistry of uranium, $22,000.

California Institute of Technology. N. Davidson. Complex ions and reaction mechanisms in solution, $3700.

University of California. C. S. Garner. Isotopic exchange reactions, $14,810.

Carnegie Institute of Technology. R. Smoluchowski. Properties of grain boundaries and lattice imperfections, $32,619.

Carnegie Institute of Technology. R. Smoluchowski. Radiation effects, $37,400.

Columbia University. W. W. Havens, Jr. Neutron spectroscopy and nuclear physics, $524,180.

Columbia University. J. L. Kulp. Uranium-lead method of age determination, $30,348.

Duke University. H. W. Newson. Fast neutron cross-sections and shell structure, $87,166.

University of Florida. D. C. Swanson. Electrostatic generator program, $10,295.

University of Florida. G. B. Butler. Studies in the preparation and properties of quaternary ammonium ion-exchange resins, $11,580.

Fordham University. M. Cefola. Studies on formation of complexes by thenoyltrifluoroacetate and other chelating agents, $7495.

Great Lakes Carbon Corporation. L. H. Juel. High density graphite, $23,995.

Illinois Institute of Technology. H. E. Gunning. The fundamental mechanisms for the decomposition of organic molecules by metal-photosensitization and other collisions of the second kind, $16,130.

University of Illinois. H. G. Drickamer. Mechanism of molecular motion as determined from diffusion and thermal diffusion measurements, $16,090.

University of Illinois. F. Seitz. Experimental and theoretical investigation of radiation damage in solid materials, $108,267.

Kansas State College. C. M. Fowler. Precision beta-ray spectroscopy, $7000.

Massachusetts Institute of Technology. F. H. Norton. Study of metal-ceramic interactions at elevated temperatures, $24,440.

Massachusetts Institute of Technology. P. M. Hurley. Investigations of isotopic abundances of strontium, calcium, and argon in certain minerals, $29,630.

University of Michigan. H. R. Crane. 42-inch cyclotron program, $119,390.

University of Minnesota. J. H. Williams. 50 Mev linear proton accelerator, $109,250.

University of Nebraska. T. Jorgensen, Jr. Mechanisms of energy transfer of slow ions, $12,420.

State University of N.Y. Research Foundation. O. E. Lanford. Concentration of nitrogen-15 by chemical exchange, $10,604.

North Carolina State College. K. O. Beatty, Jr. Measuring the thermal conductivity of poor conductors, $5056.

North Carolina State College. F. P. Pike. Performance of contractors for liquid-liquid extraction, $20,965.

Pennsylvania State College. T. F. Bates. An investigation of the mineralogy and petrography of uraniferous shales and lignites, $68,645.

University of South Carolina. O. D. Bonner. Fundamental Studies of ion-exchange equilibria, $2425.

Stanford University. E. L. Ginzton. Limitations of electron linear accelerators, $194,942.

Stanford University. O. C. Shepard. Resistance of materials to environments of molten lead and bismuth, $42,200.

Syracuse University. B. P. Burtt. Mechanism of gaseous radiation chemical reactions and the chemical reactions of electrons, $14,021.

University of Texas. G. H. Ayres. Spectrophotometric quantitative determination of the platinum metals, $9063.

University of Texas. G. W. Watt, Unusual oxidation states of transition elements, $18,000.

Tufts College. T. R. P. Gibb, Jr. Research on hydrides, $57,780.

Vanderbilt University. S. K. Haynes. Precision beta ray spectroscopy, $5216.

State College of Washington. H. W. Dodgen. The formulae and stability of complex ions in solution, $4644.

University of Wisconsin. R. G. Sachs. Theory of light nuclei, $11,650.

Yale University. H. S. Harned. Diffusion coefficients of electrolytes and molecules, $15,589.

In September the **Damon Runyon Memorial Fund** allocated $181,670 to research. A list of the grants follows.

Columbia University-College of Physicians and Surgeons. A. Gellhorn, Director of the Institute of Cancer Research, $79,110.

American Museum of Natural History, Lerner Marine Laboratory. C. M. Breder. Fundamental studies of the environmental and endocrine control of cell proliferation, $10,000.

Memorial Center for Cancer and Allied Diseases. J. J. Nickson and J. S. Laughlin. Studies to evaluate the role of high-energy radiation in cancer patients, $92,000. R. C. Mellors. Quantitative analysis of the cell by interference microscopy, $9500. O. H. Pearson. The effects of altered hormonal environment on the growth of carcinoma of the breast in women, $10,000.

University of Oregon Medical School. T. B. Fitzpatrick, A. B. Lerner, and H. S. Mason. Metabolism of melanomas, $17,000.

Chicago Medical School. Metastatic dissemination of tumors induced by cortisone, $4860.

New Mexico Highlands University. R. K. Robins. Synthesis of some imidazo (c) pyridines as potential purine antagonists, $4800.

Fellowships

H. Maisin, for project at the Donner Laboratory for Medical Physics, University of California, $4800.

J. G. Freymann, for project at Massachusetts General Hospital, $4800.

L. L. Alisangco, for study at Blood Research Laboratory, New England Center Hospital, $3600.

S. G. A. Alivisatos, for study at the Rockefeller Institute for Medical Research, $3600.

H. Isler, for study at McGill University, $4000.

Sister M. Angelice Seibert, for study at St. Louis University Medical School, $3600.

Eli Lilly and Company recently announced the following research grants:

University of Chicago. M. E. Krahl, Dept. of Physiology. Insulin and related subjects.

Cornell University. D. B. Melville, Dept. of Biochemistry, Medical College. Biochemistry of ergothioneine.

State University of Iowa. G. F. Lata, Dept. of Biochemistry. Enzymatic synthesis of steroid nucleus.

North Texas State College. J. J. Spurlock, Dept. of Chemistry. Barbituric acids.

Northwestern University. E. A. Zeller, Dept. of Biochemistry. Amine oxidases and the metabolism of basic substances.

University of Notre Dame. J. A. Reyniers, Dept. of Bacteriology, Lobund Institute. Basic nutrition using the germfree animal technique.

Rice Institute. R. B. Turner, Dept. of Chemistry. Heats of reaction in the steroid series.

University of Southern California. N. Kharasch, Dept. of Chemistry. Relationship between structure and thyroxine-like activity.

State College of Washington. C. M. Stevens, Dept. of Chemistry. Sulfur metabolism and penicillin.

Washington University. C. F. Cori, Dept. of Pharmacology and Biochemistry. Insulin and related topics.

Western Reserve University. E. W. Sutherland, Jr., Dept. of Pharmacology. Mechanism of the action of hormones, studying primarily the hyperglycemic factor and epinephrine.

The **National Science Foundation** has announced 123 awards totaling about $1,332,000 for research in the biological and the physical sciences, and to support studies and conferences on science, scientific information exchange, compilation of scientific personnel information, and travel of American scientists to international scientific meetings. This is the first group of awards to be made during fiscal year 1954 by the Foundation for the support of basic research and related matters. A list of the grants follows:

University of Chicago. W. A. Hiltner, Dept. of Astronomy. Interstellar polarization, 2 yrs., $10,900.

University of Chicago. G. P. Kuiper, Dept. of Astronomy. Physical and statistical study of the asteroids, 2 yrs., $23,000.

Harvard University. H. Shapley, Dept. of Astronomy. The stellar corona surrounding our discoidal galactic system, 1 yr., $3800.

Northwestern University. K. A. Strand, Dept. of Astronomy. Photographic observation of double stars, 2 yrs., $6500.

Yale University. D. Brouwer, Dept. of Astronomy. Systems of fundamental catalogues from observations of selected minor planets, 2 yrs., $11,500.

Boston University. N. N. Lichtin, Dept. of Chemistry. Ionic dissociation equilibria in solutions in liquid sulfur dioxide, 2 yrs., $12,900.

Brigham Young University. J. R. Goates, Dept. of Chemistry. Mechanism of adsorption of ions by silicate minerals, 1 yr., $4400.

Central State College. E. O. Woolfolk, Dept. of Chemistry. *p*-Phenylazobenzoyl chloride for identification and separation of alcohols, amines, and phenols, 2 yrs., $3100.

Columbia University. G. Stork, Dept. of Chemistry. Synthesis of the polycyclic di- and tri-terpenes, 2 yrs., $13,300.

University of Illinois. B. R. Ray, Dept. of Chemistry. Transference numbers of salts in nonaqueous solvents, 1 yr., $5300.

University of Illinois. E. C. Taylor, Jr., Dept. of Chemistry. An investigation of the pyridino-pyrimidines, 2 yrs., $5000.

Kenyon College. B. M. Norton, Dept. of Chemistry. Liquid phase photochemical reactions, 3 yrs., $4600.

Massachusetts Institute of Technology. G. Swain, Dept. of Chemistry. Quantitative correlation of relative rates of polar displacement reactions, 3 yrs., $13,000.

State University of New York. M. Szwarc, Dept. of Chemistry, School of Forestry. Heats of formation of radicals and of bond dissociation energies, 2 yrs., $16,000.

Pennsylvania State College. N. C. Deno, Dept. of Chemistry. Factors governing stability of carbonium ions, 2 yrs., $4600.

Rice Institute. R. B. Turner, Dept. of Chemistry. Total synthesis in the steroid series, 2 yrs., $16,300.

University of South Carolina. D. F. De Tar, Dept. of Chemistry. Intramolecular reactions of free radicals, 2 yrs., $13,100.

Vanderbilt University. D. E. Pearson, Dept. of Chemistry. Mechanisms of electrophilic reactions, 2 yrs., $9200.

University of Virginia. R. E. Lutz, Dept. of Chemistry. Stereochemistry and effectiveness of conjugation in chalcones and related systems, 2 yrs., $6600.

State College of Washington. G. W. Stacy, Dept. of Chemistry. Addition of thiols to Schiff base systems, 1 yr., $4100.

University of Washington. B. S. Rabinovitch, Dept. of Chemistry. Kinetics of homogeneous unimolecular isomerization reaction, 2 yrs., $12,400.

University of Wisconsin. A. L. Wilds, Dept. of Chemistry. Total synthesis of nonaromatic steroids, 1 yr., $8600.

Yale University. B. Owen, Dept. of Chemistry. The dielectric constants of liquids at high pressures, 1 yr., $3800.

University of California. R. Y. Stanier, Dept. of Bacteriology. Physiology and photosynthetic bacteria, 3 yrs., $20,700.

State University of Iowa. R. B. Wylie, Dept. of Botany. New methods in leaf research, 15 mos., $5400.

University of Pennsylvania. C. E. Wilde, School of Dentistry. Embryogenesis of the vertebrate head, 2 yrs., $10,800.

Brown University. R. B. Montgomery, Dept. of Oceanography. Analysis of serial oceanographic observations, 2 yrs., $12,200.

University of Chicago. H. C. Urey, Institute for Nuclear Studies. Isotopic abundances relating to geochemical research, 1 yr., $21,400.

Columbia University. W. H. Bucher, Dept. of Geology. Geologic investigation of the tectonic settling of land-masses adjacent to the Puerto Rican Trench, 1 yr., $14,000.

University of Illinois. G. W. White, Dept. of Geology. Properties of glacial tills, 15 mos., $11,800.

University of Miami. R. N. Ginsburg, Marine Laboratory. Geological role of some blue-green algae, 6 mos., $3300.

University of Nebraska. R. L. Threet, Dept. of Geology. Structures of the Colorado Plateau Margin in southwestern Utah, 2 yrs., $4400.

Princeton University. W. T. Thom, Jr., Dept. of Geological Engineering. Crustal deformation in portions of the Great Plains and Cordilleran regions, 1 yr., $8700.

Wayne University. W. H. Parsons, Dept. of Geology. Igneous geology in the Beartooth Mountain area, Wyoming, Montana, 6 mos., $4000.

University of Arizona. A. R. Mead, Dept. of Zoology. Population decline of the giant African snail, 1 yr., $8300.

Michigan State College. G. W. Prescott, Dept. of Botany. Alpine and arctic algae, 1 yr., $2200.

St. Louis University. B. J. Luyet, Institute of Biophysics. Survival of vitrified and dried organisms, 1 yr., $4500.

Polytechnic Institute of Brooklyn. J. C. Chu, Dept. of Chemical Engineering. Drying with superheated vapors, 2 yrs., $3500.

University of California. W. T. Thomson, Dept. of Engineering. Wave propagation through hydrocarbons, 2 yrs., $9600.

Georgia Institute of Technology. W. T. Ziegler, Dept. of Chemical Engineering. Studies of compounds for superconductivity, 2 yrs., $13,000.

University of Kentucky. C. S. Crouse and J. P. Hammond, Dept. of Mining and Metallurgical Engineering. Effect of deformation temperature on the rolling textures of metals, 1 yr., $9000.

Massachusetts Institute of Technology. J. Wulff, Dept. of Metallurgy. Adsorption of gases on solid metals, 1 yr., $8600.

University of Minnesota. E. L. Piret, Dept. of Chemical Engineering. Reaction and dislocation kinetics of crushing and grinding, 2 yrs., $15,000.

New York University. Y. C. Liu, Dept. of Metallurgy. Effect of crystal orientation in cold-rolled and recrystallized textures of copper, 18 mos., $6000.

North Carolina State College. N. L. Nemerow, Dept. of Engineering Research. Mechanism of biochemical oxidation of organic matter, 1 yr., $7000.

Pennsylvania State College. L. W. Hu and J. Marin, Dept. of Engineering. Creep stress-strain-time relations for combined stresses, 2 yrs., $13,000.

Pennsylvania State College. A. H. Waynick, Dept. of Electrical Engineering. Detecting solar and upper atmosphere phenomena by long-wave radio methods, 1 yr., $12,000.

Pratt Institute. G. B. Diamond, Dept. of Chemical Engineering. Selective electrolytic reduction of carbocylic unsaturated compounds, 2 yrs., $10,000.

Swarthmore College. C. Barus, Dept. of Electrical Engineering. Electronic instrumentation in neurophysiology, 1 yr., $8500.

University of Texas. W. L. Moore, Dept. of Civil Engineering. Diffusion of a two-dimensional submerged jet, 1 yr., $10,000.

Alabama Polytechnic Institute. C. D. Squiers and L. E. Gregory, Dept. of Animal Husbandry and Nutrition. Fertility, viability, and growth in the rat, 3 yrs., $18,000.

University of California. C. M. Rick, Dept. of Vegetable Crops. Cytogenetic studies in the genus *Lycopersicon*, 3 yrs., $7000.

Rancho Santa Ana Botanical Garden, V. Grant, Biosystematist. Genetics of the genus *Gilia*, 3 yrs., $7700.

University of Rochester. K. W. Cooper, Dept. of Biology. Patterns of chromosome segregation, 3 yrs., $24,000.

Texas Agricultural Experiment Station. H. H. Hadley, Dept. of Genetics. Cytogenetic relationships among sorghums, 3 yrs., $3900.

Washington University. H. L. Carson and H. D. Stalker, Dept. of Zoology. Investigation of *Drosophila* and *Diptera*, 3 yrs., $11,500.

Haverford College. R. C. James, Dept. of Mathematics. Implications of the existence of Banach spaces, 1 yr., $2500.

Illinois Institute of Technology. L. R. Wilcox, Dept. of Mathematics. Imbedding theorems and topologies for lattices, 1 yr., $7000.

Northwestern University. A. Rosenberg and D. Zelinsky, Dept. of Mathematics. Galois theory of rings, 1 yr., $6800.

Purdue Research Foundation. C. R. Putnam, Dept. of Mathematics. Investigation of singular boundary value problems and operators in Hilbert space, 2 yrs., $12,000.

University of Virginia. E. J. McShane, School of Mathematics. Convergence problems in partially ordered spaces, 1 yr., $1700.

Wayne University. C. Goffman, Dept. of Mathematics. Lower semi-continuous functionals and surface area, 1 yr., $8200.

University of Wisconsin. R. H. Bing, Dept. of Mathematics. Imbedding sets in manifolds, 1 yr., $5400.

U.S. Embassy, London, R. W. G. Wyckoff, Science Attaché. Electron microscopic study of the structure of biological tissues, 1 yr., $3000.

Cornell University. H. A. Scheraga, Dept. of Chemistry. Hydrodynamic properties of proteins, 3 yrs., $15,500.

Duquesne University. N. C. Li, Dept. of Chemistry. Metal-protein interactions, 2 yrs., $13,000.

The Johns Hopkins University. W. C. McElroy, McCollum-Pratt Institute. Biological conversion of chemical energy to light, 3 yrs., $15,000.

Montana State College. R. H. McBee, Dept. of Botany and Bacteriology. Bacterial cellulose decomposition, 3 yrs., $12,000.

New York University. M. Levy, Dept. of Chemistry. Chemical structure of proteins, 3 yrs., $18,000.

University of Pennsylvania. M. J. Coon, Dept. of Physiological Chemistry. Amino acid metabolism, 3 yrs., $25,000.

University of Pittsburgh. M. A. Lauffer, Dept. of Biophysics. Biophysical studies on plant viruses, 2 yrs., $16,000.

Washington University. M. Cohn, Dept. of Biological Chemistry. Mechanism of phosphorylation and phosphate transfer reactions, 3 yrs., $18,000.

University of Wisconsin. R. A. Alberty and R. M. Bock, Dept. of Chemistry. Investigation of enzyme fumarase, 2 yrs., $15,000.

Yale University. E. C. Pollard and F. Hutchinson, Dept. of Physics. X-ray studies of viruses, 2 yrs., $13,000.

University of California. C. Kittel, Dept. of Physics. Interaction of fundamental particles with solid state systems, 2 yrs., $11,800.

Case Institute of Technology. L. L. Foldy and M. J. Klein, Dept. of Physics. Theoretical research in nuclear and solid state physics, 2 yrs., $15,600.

University of Connecticut. C. A. Reynolds, Dept. of Physics. Hydrodynamics of liquid helium II, 1 yr., $8400.

Duke University. L. W. Nordheim and E. Greuling, Dept. of Physics. Theory of nuclear shell study, 2 yrs., $20,600.

University of Illinois. D. W. Kerst, Dept. of Physics. Photo production of pi-mesons, 2 yrs., $12,000.

Kent State University. A. A. Silvidi, Dept. of Physics. Continuous cloud chambers, 1 yr., $3000.

Marquette University. A. G. Barkow, Dept. of Physics. Elementary particle reactions in photographic emulsions, 2 yrs., $5500.

Michigan State College. E. A. Hiedemann, Dept. of Physics. Light diffraction and ultrasonic waves, 2 yrs., $10,600.

University of Nebraska. D. C. Moore, Dept. of Physics, Half-life of positrons in condensed matter, 2 yrs., $10,000.

New York University. A. Beiser, Dept. of Physics. Time sensitivity in nuclear emulsions, 1 yr., $7200.

University of Oklahoma. J. R. Nielsen, Dept. of Physics. Vibrational spectra of compounds in different states of aggregation, 3 yrs., $21,200.

University of Puerto Rico. A. Cobas, Dept. of Physics. Zenith angle variation of cosmic rays, 1 yr., $6600.

Purdue Research Foundation. F. J. Belinfante, Dept. of Physics. Elementary particles and field theory, 2 yrs., $6000.

Rice Institute. C. F. Squire, Dept. of Physics. Studies in solid state physics, 1 yr., $14,300.

Southwestern at Memphis. D. E. Matthews, Dept. of Physics. Critical energy for secondary electron research, 1 yr, $9400.

American Museum of Natural History. T. C. Schneirla, Dept. of Animal Behavior. Development of behavior patterns in lower mammals, 2 yrs., $16,500.

Yale University. F. D. Scheffield, Dept. of Psychology. A comparison of autonomic conditioning and skeletal instrumental learning, 3 yrs., $11,550.

California Institute of Technology. J. Bonner, Div. of Biology. Energetic coupling in plant systems, 1 yr., $8500.

University of Kansas. J. Jensen and A. Werder, Dept. of Medical Microbiology. Host-parasite relationships between viruses, helminths, and protozoa, 3 yrs., $14,500.

Oklahoma Agricultural and Mechanical College. R. J. Sirny, Dept. of Agric. Chemistry Research. Sodium and potassium requirements of lactic acid, 2 yrs., $7900.

Oregon State College. V. H. Cheldelin, Dept. of Chemistry. Nutrition and metabolism of insects, 2 yrs., $15,000.

University of Pittsburgh. R. Bentley, Dept. of Biochemistry and Nutrition. Carbohydrate metabolism in molds, 3 yrs., $16,500.

University of Rochester. E. F. Adolph, School of Medicine and Dentistry. Physiological development of regulatory functions, 3 yrs., $24,000.

University of Tennessee. D. F. Holtman, Dept. of Bacteriology. Role of amino acids in the host-parasite relationship, 1 yr., $5000.

Vanderbilt University. C. R. Park, Dept. of Physiology. Factors influencing glucose penetration into cells, 2 yrs., $16,000.

University of Washington. E. C. Roosen-Runge, Dept. of Anatomy. Mammalian spermatogenesis, 2 yrs., $10,000.

Yale University. M. Foster, Osborn Zoological Laboratory. Inherited pigmentary variations, 2 yrs., $5800.

Yale University. W. Vishniac, Dept. of Microbiology. Enzymatic reactions in photosynthesis and chemosynthesis, 3 yrs., $10,000.

Academy of Natural Sciences of Philadelphia. J. A. G. Rehn, Curator, Dept. of Insects. Orthoptera of North America, 2 yrs., $16,000.

Duke University. L. E. Anderson, Dept. of Botany. Bryophytes of the Ozarks, 18 mos., $4600.

University of New Hampshire. M. H. Pettibone, Dept. of Zoology. The polychaete annelids of New England, 2 yrs., $11,500.

New York Botanical Garden. B. Maguire, Curator. The flora of the Guayana Highland, 2 yrs., $12,400.

University of North Carolina. Z. P. Metcalf, Div. of Biological Sciences. Catalogue of world homoptera, 2 yrs., $16,000.

University of Pennsylvania. J. M. Fogg, Jr., Dept. of Botany. The flora of Pennsylvania, 1 yr., $4600.

University of Washington. P. L. Illg, Dept. of Zoology. Systematics of North American copepods, 3 yrs., $5900.

For Attendance at International Meetings:

Australian–New Zealand Association for the Advancement of Science Symposia on Nuclear Physics, Geophysics and Astrophysics. L. W. Alvarez, Dept. of Physics, University of of California, $1150.

Fifth International Congress of Neurology. C. S. Greene, Dept. of Surgery, College of Medicine, Howard University, $600.

For a Clearinghouse for Scientific Manpower Data:

National Academy of Sciences. S. Meyer, Executive Director, AIBS. Register of scientific and technical personnel in the field of biology, 1 yr., $19,200.

National Academy of Sciences. M. H. Trytten, Office of Scientific Personnel, NRC. Studies on doctoral degrees, 1 yr., $12,000.

For Conferences in Support of Science:

American Academy of Arts and Sciences. Cosponsored conference on validation of scientific theories, $5000.

Beloit College. Cosponsored conference on geology research in colleges, $5000.

Carnegie Institution of Washington. Cosponsored conference on radio astronomy, $8500.

University of Chicago. Cosponsored conference on nuclear processes in geological settings, $4800.

Columbia University. Symposium on role of proteins in the transport of ions across membranes, $4100.

For Dissemination of Scientific Information:

Library of Congress. D. E. Gray, Chief, Technical Information Division. Study of publications stemming from defense-related technical reports, 1 yr., $4000.

Library of Congress. R. L. Zwemer, Chief, Science Division. Establishing and operating a center for recording, reporting, duplicating, and distributing translations of scientific literature, 1 yr., $29,500.

U.S.D.A. Graduate School. R. R. Shaw, Librarian. Investigation of the effectiveness of information sources available to American scientists, 1 yr., $20,700.

For Policy Studies:

American Academy of Arts and Sciences. A. H. Dupree. History of activities of the Federal Government in science, 2 yrs., $29,400.

American Psychological Association. Continuation of study of the development and status of psychology, $45,000.

In its 3rd quarter report for 1953 the **Rockefeller Foundation** listed the following scientific research grants:

Institute of Physical Chemistry, University of Upsala, Sweden. S. Claesson. Research in photosynthesis, 5 yrs., $35,000.

University of London. H. J. Eysenck, Institute of Psychiatry. Studies on the psychological effects of frontal-lobe operations, 3 yrs., $23,400.

University of Manchester. E. R. H. Jones. Research on the chemistry of biologically important materials, 5 yrs., $45,000.

University of Cambridge, School of Biochemistry. Purchase of equipment for research, $25,000.

University of Oxford. Sir Howard Florey, Sir William Dunn School of Pathology. Purchase of equipment for research on antibiotics and the chemistry of lipids, $7500.

University of Paris. René Wurmser, Laboratory of Physical Chemistry. Construction of equipment and general expenses of research, 3 yrs., $15,000.

University of Amsterdam. M. W. Woerdeman, Laboratory of Anatomy and Embryology. Research in experimental embryology, 3 yrs., $15,000.

Karolinska Institute, Stockholm. F. S. Sjöstrand, Ipstitute of Anatomy. Research in electron microscopy, 2 yrs., $24,000.

University of Birmingham, England. A. R. Peacocke, Dept. of Chemistry. Research on the chemistry of nucleic acids, $5000.

London School of Hygiene and Tropical Medicine. C. N. Davies. To visit centers in the field of occupational health in the U.S., $1925.

Society for General Microbiology, England. Travel expenses of two American delegates to Society's symposium on autotrophic microorganisms, $1200.

University College, London. Purchase of recording apparatus for Dr. Abercrombie of the Dept. of Anatomy, $924.

University College of South Wales. Arthur J. C. Wilson. Travel expenses to conference on configuration of polypeptide chains at the California Institute of Technology, $500.

University of Brussels. H. Chantrenne. Research on the chemistry of proteins, $4000.

Marine Station of Endoume, University of Marseilles. J. M. Pérès. Research in marine biology and ecology, 2 yrs., $5000.

University of Nancy. René Wolff, Faculty of Medicine. Research in biological chemistry, $3000.

University of Padua. L. Toniolo, Faculty of Agriculture. Travel expenses to observe work in Wales in genetics and plant breeding, $700.

University of Naples. F. Fidanza, Institute of Biological Chemistry. Purchase of apparatus and supplies for research, $540.

University of Leiden. E. Havinga. Research on the chemistry of biologically active molecules, $7500.

Federal Technical Institute, Zurich. F. Ruch, Institute of Plant Physiology. Purchase of equipment, $4000.

Dept. of Public Health, Government of Western Australia. W. A. Young, Medical Laboratories. Travel expenses to observe public health laboratory methods in the U.S., $1350.

Christian Medical College, India. C. E. Taylor, Dept. of Preventive Medicine, $3000.

Anatomical Society of India. For meeting to discuss teaching and research in Indian medical colleges, $2000.

Medical College, Trivandrum, South India. Dept. of Anatomy. Purchase of equipment and supplies, $1800.

Mysore State Public Health Dept., India. S. Ananthaswamy. To observe public health laboratory methods and research in India, $1200.

Kyushu University Medical School, Japan. Purchase of equipment for the Laboratory of Clinical Physiology, $9,440.

St. Luke's College of Nursing, Tokyo. Purchase of supplies needed to establish its educational program, $4200.

Research Institute of Population Problems, Tokyo. A. Okasaki, Director. Travel expenses to visit centers of population study in U.S., $775.

University of Otago, New Zealand. M. McGeorge, Dunedin Hospital. To observe pediatric instruction and operation of pediatric hospitals in the U.S. and Canada, $2250.

Secretariat of Agriculture, Brazil. J. W. Costa, Div. of Animal Production, $2500, and A. M. Elias, Div. of Plant Production, $2500. Travel expenses to visit agricultural centers in U.S., Mexico, and Colombia.

University of Rio Grande do Sul. A. R. Cordeiro, Faculty of Philosophy. Research in *Drosophila* genetics and ecology of reptiles, $2400.

Southern Agronomic Institute, Brazil. J. A. Deslandes. Expenses for research training in U.S. and Mexico, $1600.

University of São Paulo. H. A. Rothschild, Dept. of Histology and Embryology. Expenses while studying in U.S., $1100.

Biological Institute, São Paulo. K. M. Silberschmidt. Travel expenses for visits to Colombian and Mexican agricultural programs, $360.

University of Chile. H. Alessandri, Dept. of Internal Medicine. Purchase of equipment, $7500.

University of Chile. O. Cori, Institute of Physiology. Purchase of equipment, $7500.

Catholic University of Chile. J. Vial, Dept. of Anatomy. Purchase of equipment, $5850.

Catholic University of Chile. H. Croxatto, Dept. of Physiology. Expenses of visit to U.S. departments of physiology, $725.

Juan Noe Institute of Biology. G. Hoecker. Travel expenses, $500.

Colombian Institute of Cotton Development. To contract assistance of American technicians in organization and development of field research program, $10,000.

University of Valle, Colombia. Purchase of medical source books for library, $9000.

University of San Luis Potosi, Mex. Purchase of equipment and supplies for Dept. of Physiology, $2000.

University of Guadalajara, Mex. Purchase of equipment for Dept. of Physiology and Pharmacology, $2000.

University of San Marcos, Peru. J. F. Figueroa, Faculty of Veterinary Medicine. Expenses of visits to U. S. veterinary medicine centers, $500.

Hôtel Dieu de Montreal. For salary of research chemist in Dept. of Clinical Research, $3997.

Harvard University. B. F. Skinner, Dept. of Psychology, and H. C. Solomon, Dept. of Psychiatry. Study of the application of techniques of analysis to the behavior of psychotics, $5000.

Institute for Advanced Study. B. B. Mandelbrot. Study of communication theory in U.S., $5000.

Woods Hole Marine Biological Laboratory. Research analysis of the laboratory's operations, $3500.

University of Wisconsin. To invite H. Lundegardh, Upsala, Sweden, to visit U.S., $2000.

University of North Carolina. H. T. Clark, Jr., Div. of Health Affairs. To observe centers of medical care in U.S., $1450.

University of Michigan. T. Francis, Jr., Dept. of Epidemiology. To visit virus research centers in United Kingdom and Europe, $1125.

Meetings and Elections

The **American Academy of Dental Medicine** will hold its annual Mid-Winter Meeting and Luncheon at the Hotel Statler, New York City, on Dec. 6. There will be a business meeting for members at 10:30 A.M. Following the luncheon, there will be a symposium on geriatrics. Participants will be Prof. Alonzo F. Myers of New York University, Dr. Henry M. Goldman of Boston, and Dr. C. Ward Crampton of New York City; Dr. Joseph I. Echikson of Newark, N.J., will act as moderator. All members and interested dentists and physicians are cordially invited. For reservations and program, address the National Secretary, Dr. William M. Greenhunt, 124 East 84th Street, New York 28, N.Y.

The 48th Annual Meeting of the **American Sociological Society** was held Aug. 30–Sept. 1 at the University of California at Berkeley. This was the first meeting of the Society to be held west of the Rocky Mountains and it was attended by over 500 sociologists from all parts of the country The program was largely composed of short research reports, abstracts of which were available in advance. Some 175 papers, ranging from such relatively new fields as reference group and role theory to the longer established fields of criminology and race relations, were delivered during the course of the 3-day session.

The 6th annual **Conference on Electronics and Nucleonics in Medicine,** sponsored by the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Instrument Society of America, will be held in the Hotel New Yorker, New York City, Nov. 19–20. The 2-day meeting will include sessions on diagnostic devices, x-rays, and blood measurements. Papers will be presented by leaders in the fields of instrumentation and nucleonics.

Recently the National Science Foundation sponsored a **Conference on Geology Research in Colleges** at Beloit College, Wis. About 30 geologists from small

geology departments in colleges throughout the country attended the conference to discuss problems faced by departments having fewer than five teachers. Only a limited amount of research is undertaken at many colleges because of the heavy teaching loads of the staffs and the inability of the colleges to compete with larger research institutions for federal and industrial research funds. At the same time, however, the colleges are an important source of young scientists who continue graduate work in science at larger institutions.

The geology conference at Beloit College was similar to a conference on physics research in colleges held at Amherst College last May, also sponsored by the Foundation. Both conferences were designed to stimulate more scientific research activities in the colleges and to suggest appropriate methods by which government and industry may aid in such efforts.

The Committee for Old World Archaeology, the formation of which was announced in a previous issue (SCIENCE, **116**, 165 [1952]), has completed its investigation. As a result of its recommendations, a permanent organization, the **Council for Old World Archaeology,** has been formed and incorporated. The control of the Council is vested in charter members, who were nominated by nine organizations, as follows: Jotham Johnson, Archaeological Institute of America; Lauriston Ward, American Anthropological Association; Robert J. Braidwood, American Schools of Oriental Research; Irving Rouse, Society for American Archaeology; Bruce Howe, American School of Prehistoric Research; Richard K. Beardsley, Section H, AAAS; Schuyler Cammann, American Oriental Society; J. Lawrence Angel, American Association of Physical Anthropologists; George C. Miles, American Numismatic Society.

At a meeting held in Cambridge, Mass., May 23, 1953, the following were elected trustees: pres., Lauriston Ward; clerk and treas., Noel Morss; and J. Lawrence Angel, Wendell C. Bennett, Robert J. Braidwood, Schuyler Cammann, Bruce Howe, Jotham Johnson, George C. Miles, C. R. Morey, Irving Rouse, and Erik Sjöqvist.

A meeting of the trustees was held in New York, May 23 and 24. It was agreed that the Council should concern itself with the archaeology of all Europe, Africa, Asia, and Oceania, for all periods of time, and that its major activity should be the publication of information in this field, chiefly in the form of annual surveys of archaeological news and selected annotated bibliographies. Plans for financing are now under way and it is hoped that publication can begin some time in 1954.

An **International Federation for Planned Parenthood** was formed on the closing day of the 4th International Congress of the Planned Parenthood Movement held in Stockholm last summer. Margaret Sanger, pioneer of the movement, was elected President of the new federation, and Lady Rama Rau of India was appointed Executive Chairman.

The **Mid-Century Conference on Resources for the Future** will take place in Washington on Dec. 2–4. Resources for the Future, Inc., a nonprofit corporation fostering research and education in the field of natural resources, has called the Mid-Century Conference to survey the nation's natural resources, the demands upon them, and methods of using and conserving them. For this purpose, the corporation has received a grant from the Ford Foundation.

The steering committees are laying the groundwork for eight sectional meetings which will run concurrently during the Conference. Since a 3-day meeting will not allow time for discussion of all matters associated with natural resources, the steering committees are meeting in advance to reach agreement on the most urgent issues with which the Conference should deal. These issues will be underlined in section papers, now in preparation under committee supervision, to be distributed in advance for use as discussion guides. In addition to heading up the work of their steering committees, all chairmen and cochairmen will be prominently identified with the Conference itself as presiding officers over the eight sectional meetings. Committee members, too, will attend the Conference and take active part in the discussions. The complete list of sections and their chairmen and cochairmen is as follows:

Section I—*Competing Demands for Land Use.* Charles C. Colby of Chicago, professor emeritus of geography at the University of Chicago, and Harry R. Wellman of Berkeley, Cal., professor of agricultural economics and vice president of the University of California.

Section II—*Utilization and Development of Land Resources.* Lloyd E. Partain of Merion, Pa., sales manager of Curtis Publishing Co. and vice chairman of the Committee on Conservation of Renewable Resources of the National Association of Manufacturers, and Samuel T. Dana of Ann Arbor, Mich., dean emeritus of the School of Natural Resources, University of Michigan.

Section III—*Water Resource Problems.* Gilbert F. White of Haverford, Pa., president of Haverford College, and Abel Wolman of Baltimore, professor of sanitary engineering at Johns Hopkins University.

Section IV—*Domestic Problems of Nonfuel Minerals.* Evan Just of New York City, vice president of Cyprus Mines Corporation, and John Vanderwilt of Golden, Colo., president of the Colorado School of Mines.

Section V—*Energy Resource Problems.* Farrington Daniels of Madison, Wis., head of the Department of Chemistry at the University of Wisconsin and president of the American Chemical Society, and George M. Gadsby of Salt Lake City, president and general manager of Utah Power & Light Co.

Section VI—*U.S. Concern With World Resources.* Edward S. Mason, dean of the Graduate School of Public Administration, Harvard University, and E. G. Collado of New York City, assistant treasurer of Standard Oil Company (N.J.).

Section VII—*Problems in Resources Research.* Earl P. Stevenson of Cambridge, Mass., president of the engineering and industrial research firm of Arthur D. Little, Inc., of Cambridge, and Ralph E. Gibson of Silver Spring, Md., director of the Johns Hopkins University Applied Physics Laboratory at Silver Spring.

Section VIII—*Patterns of Cooperation.* H. Christian Sonne of New York, president of Amsinck, Sonne & Co., New York City merchant bankers, and chairman of the board of trustees of National Planning Association, and Luther H. Gulick of New York, president of the Institute of Public Administration.

The **National Science Foundation** has established a permanent **Advisory Panel on Minerals Research** to advise the Foundation in developing policy on basic research in the field of mineral discovery and exploration. This action followed the recommendation of a temporary advisory group appointed by the Foundation in 1952 to review recommendations of the President's Materials Policy Commission relating to the undertaking of an extensive program of basic scientific research, and of the technical development of improved techniques and instruments of exploration for minerals. The new panel is made up of representatives from the mining and petroleum industries, universities, and government. Panel members are:

James Boyd, Kennecott Copper Company, New York, N.Y., (*chairman*)
Allen V. Astin, National Bureau of Standards, Washington, D.C.
John G. Bartram, Stanolind Oil & Gas Company, Tulsa, Okla.
Alan Bateman, Yale University, New Haven, Conn.
Arthur H. Bunker, Climax Molybdenum Company, New York, N.Y.
Gordon L. Davis, Geophysical Laboratory, Washington, D.C.
Maurice Ewing, Columbia University, New York, N.Y.
Paul D. Foote, Gulf Research and Development Co., Pittsburgh, Pa.
L. C. Graton, Harvard University, Cambridge, Mass.
John Gustafson, M. A. Hanna Company, Cleveland, Ohio.
C. K. Leith, National Research Council, Washington, D.C.
Thomas Nolan, U.S. Geological Survey, Washington, D.C.
William W. Rubey, National Research Council, Washington, D.C.
Louis Slichter, University of California, Los Angeles.
John Vanderwilt, Colorado School of Mines, Golden, Colo.
Clyde E. Williams, Battelle Memorial Institute, Columbus, Ohio
William Wrather, U.S. Geological Survey, Washington, D.C.
Paul Zinner, Bureau of Mines, Washington, D.C.

In addition to recommending the establishment of a permanent panel, the temporary committee gave considerable thought to the possible areas in which additional research is needed. It presented the Foundation with a preliminary guide to the kinds of important problems facing the United States in minerals research.

To mark the first anniversary of the death of the late President Weizmann, a number of scientific events took place at the **Weizmann Institute of Science,** Rehovoth, Israel, during the period Nov. 2–6. The new building of the Biological Institute was officially opened and the cornerstone of the Physics Institute laid. Symposia on various subjects were held (biology, biochemistry, polymers, and physics), and among those foreign scientists who participated were Professors Niels Bohr, Linus Pauling, Herman Mark, Ernest Chain, and Peyton Rous.

Miscellaneous

In August the **Chinese Association for the Advancement of Science,** Taipei, Taiwan, China, published the first issue of its monthly *Bulletin,* which is in English.

The Geological Society of America published the following article in October, 1953, issue of its *Bulletin*: "Bibliography and Index of Literature on Uranium and Thorium and Radioactive Occurences in the United States. Part 2: California, Idaho, Montana, Oregon, Washington, and Wyoming," by Margaret Cooper of the Division of Raw Materials, U.S. Atomic Energy Commission. Since this 69-page bibliography may prove helpful to both geologists and laymen interested in uranium prospecting, the Society has prepared reprints for public sale at 25 cents per copy. Remittance must accompany orders, which should be sent to: The Geological Society of America, 419 W. 117th St., New York 27, N.Y.

The final report of the **German Research Council,** prepared under Werner Heisenberg, may be obtained for $2.90 from R. Oldenbourg Verlag, Munich.

The following chemicals are wanted by the Registry of **Rare Chemicals,** Armour Research Foundation of the Illinois Institute of Technology, 35 W. 33rd St., Chicago 16: sodium pentathionate; boron tribromide; acenaphthalene; 1-7-dimethylxanthine; tetramethylethylene oxide; di-tert.-butyl silicon dichloride; anthracene-1-carboxylic acid; 3,4-dimethylpyridine; 9,-10-diaminoanthracene; beta-aminoisobutyric acid; 6-methylindole; 1,4-dibromo-2-butyne; 3,5-dihydroxycinnamic acid; pyrazine-2,3-dicarboxylic acid; 4-methyltryptophane; glycyrrhetinic acid; amygdalin; delta-tocopherol; ornithuric acid; protoanemonin.

Material relating to general **zoology** for inclusion in the review publication, for the period 1951–53, of the National Institute of Sciences of India may be sent to Dr. B. S. Chauhan, Zoological Survey of India, 34, Chittaranjan Ave., Calcutta-12.

Technical Papers

Different I.Q.'s for the Same Individual Associated with Different Intelligence Tests

Ralph Mason Dreger

Department of Psychology, Florida State University, Tallahassee

The argument over the "constancy of the I.Q." in respect to the Stanford-Binet tests, the most well-known intelligence scales, seems for the time being fairly well settled (*1*). For any one individual, the I.Q. ratio may vary widely if personal and environmental factors are changed considerably over a period of time (*2*); for the group, however, there seems to be a constancy, i.e., most individuals will not vary more than about 5 I.Q. points from one time to another.

A further question arises, however, in the light of clinical experience. What about the constancy of the same individual's I.Q. as reported on different tests at approximately the same time? Clinicians especially (*3*) have pointed out that one must report not only the ratio computed but also on what test the I.Q. was obtained, in order for a proper evaluation of the person's intelligence to be made. Even with respect to one composite test, the Wechsler Intelligence Scale for Children, Seashore (*4*) warns that clinicians should be cautious about attaching unusual meaning to differences in Verbal and Performance I.Q.'s derived from the test.

The present investigation gives a limited answer to the question concerning different I.Q.'s from different tests. Ten graduate students in psychology were trained by the writer to give individual tests; then each one tested one subject with 4 intelligence tests. Table 1 discloses the fact that selection of subjects was from above average intelligence levels for the most part; chronological ages ranged evenly from 5 years and 8 months (5–8) to 13 years and 10 months (13–10). In one case only 3 tests were given. The design was intended to duplicate the actual clinical situation where one examiner gives several tests to the same person.

TABLE 1

I.Q.'s of Ten Children on Four Intelligence Tests Each

S	CA	S–B*		Good.	Kuhl.	Arth. I	Arth. II	Arth. Leit.
		L	M					
1	5– 8			154				
	5–10	137				147	139	
2	6– 2	114		89		111		111
3	8– 1	153		123		101	102	
4	8– 2	96						
	8– 5			101		116	101	
5	8– 4			119				
	8– 5		103			115	107	
6	8–11	100		117	95		108	
7	10– 0	145		130			120	121
8	10– 1	101						
	10– 3			102		115		
9	12– 3	110						
	12– 5			105	92		111	
10	13– 7	119						
	13–10			102	112		122	

* Abbreviations refer to intelligence scales described in text.

To allow for examiners' confidence in their own skill and to increase thereby examining validity, examiners were given the following tests from which to choose: Stanford-Binet, 1937 revision, Forms L and M (one of these was required in all cases as a baseline test); Goodenough Draw-a-Man Test; Kuhlmann Tests of Mental Development; Arthur Point Scale of Performance Tests, Forms I and II; and the Arthur Adaptation of the Leiter International Performance Scale. Not more than 3 months elapsed between the administration of the first test and the fourth.

Table 1 shows that I.Q.'s derived from the same individual on different tests do differ from one another. This conclusion is supported by the fact that one of the correlations shown in Table 2 is negative and only one of the remaining positive correlations is statistically significant.

An analysis of variance and Bartlett's test for homogeneity of variance (*5*) indicate that in the case of the entire group of children there are probably no significant differences between the tests. Differences appear to be between tests on the same child.

On the assumption that the tests which yielded the highest and lowest I.Q.'s for each subject could have been by chance the two tests administered if only two were administered in any clinic, the extremes of I.Q.'s for each individual were entered in two columns as his high and low scores. Fisher's test for difference

TABLE 2

Coefficients of Concordance and Rank Correlations Among Several Intelligence Tests*

Tests	W†
Stanford-Binet, Goodenough, Arthur I	.496
Stanford-Binet, Goodenough, Arthur I, Arthur II	.525
	τ
Stanford-Binet & Goodenough	.360‡
Stanford-Binet & Arthur I	−.414
Stanford-Binet & Arthur II	.354
Goodenough & Arthur I	.138
Goodenough & Arthur II	.214
Arthur I & Arthur II	.333

* Probability levels are read from Kendall (*6*).
† Not significant in either case. W ranges only from 0 to 1.
‡ $P = 0.036$. τ ranges from −1 to 1. All significance tests are one-tailed.

scores (7) resulted in a t-ratio beyond the 0.001 level. If this procedure is not too unsound, the inference is that the highest and lowest I.Q. scores made by the same children are significantly different from each other.

Although the present experiment confounds the reliability of the examiners' test-administration with the reliability of the subjects' I.Q. scores, it is exactly from this kind of confounded situation that we are forced to draw practical conclusions about I.Q. test scores obtained in our clinics today. Therefore, it can be concluded that whereas group means on different tests of intelligence may not differ except by chance from one another, individual's I.Q.'s may differ widely and significantly from one another on different tests.

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An Improved Method for the Determination of Blood Volume Using Radioactive Iodinated Human Serum Albumen[1]

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Improving techniques for the determination of blood volume have moved this procedure from that of an investigative tool to one of direct clinical value in the management of a wide variety of clinical problems. The earliest studies involved exsanguination of experimental animals. The introduction of essentially nondiffusible dyes, such as vital red and Evans blue, and the use of carbon monoxide permitted determination of blood volumes on living patients. Technical complexity and the inability to apply these methods repeatedly at short intervals in a given patient limits their clinical usefulness.

Tagging erythrocytes with P^{32}, K^{42}, and Fe^{59} opened a new approach which, however, was still time-consuming.

In 1951, Aust *et al.* (*1*) devised a technique using 50–100 μc of I^{131} tagged human albumen.

The sensitivity of the recently available well-type scintillation counter[2] is such that 0.001 μc of I^{131} gives 895 ct/min.

[1] Supported by funds from the Nelson M. Percy Research Foundation, Augustana Hospital, Chicago, Ill.

[2] Manufactured by Nancy Woods, Chicago, Ill.

I^{131}-tagged human albumen as received from the supplier is diluted with sterile 0.85% saline solution so that 1 ml contains 3 μc. It is essential that sterile technique be observed in making the dilutions and that both the stock and diluted reagent be refrigerated.

1. A volume of the diluted stock solution calculated to contain approximately 3 μc of I^{131} is accurately drawn up to the mark in a sterile syringe, and transferred quantitatively to an oxalate tube.

2. Using the same needle and syringe (to obviate error in standardization) an identical volume (drawn to the same mark as under 1) is injected into the subject's antecubital vein.

3. After 10 min (15–20 if patient is in shock) 10 cc of blood is withdrawn from the opposite antecubital vein and placed in an oxalate tube.

4. The control volume is diluted to 1000 ml in a volumetric flask with distilled water. This dilution gives approximately 10,000 ct/min/5 ml.

5. Background is determined for two 10-ml graduated test tubes. Average 200 ct/min.

6. Five milliliters diluted control solution is pipetted into one of the 10-ml tubes, and 5 ml of the oxalated blood (well mixed) is pipetted into the second 10-ml tube.

7. Each sample is counted in the well counter for 1 min.

8. Calculation:

$$\text{Total blood volume} = \frac{(\text{control count} - \text{background}) \times 1000}{\text{test count} - \text{background}}$$

9. Centrifuge blood at 2500 rpm 20 min and hematocrit determined.

10. Procedure for repeated determinations of blood volumes: a control blood specimen is drawn before the injection of the second dose of tagged albumen to determine residual radioactivity. Then repeat entire procedure.

$$\text{Total blood volume} = \frac{(\text{control count} - \text{background}) \times 1000}{(\text{blood \#2} - \text{background}) - (\text{blood \#1} - \text{background})}$$

The total time involved in this procedure is 45 min. The total dose of radiation is 3 μc/determination.

The only serious disadvantage to this technique is the original cost of the equipment. Its advantages are speed, complete safety, and reproducibility (Table 1).

TABLE 1

Bleeding Duodenal Ulcer with no Fluid Intake During Period of Study

Date	Time	Hematocrit	TBV, cc	TBV, cc/kg	RCV, cc	RCV, cc/kg	PV, cc	PV, cc/kg
5/14	1:30 P.M.	24	3120	41.6	748	10	2372	31.6
5/14	4:30 P.M.	23	3250	43.3	747	10	2502	33.5
5/15	9:30 A.M.	19	3870	51.6	735	9.8	3145	41.8

Since there is no absolute measure of blood volume the important requirements in any clinical method are reproducibility and constancy of the normals. These requirements are fulfilled by the present method. In 42 determinations the normal range obtained corresponded closely to those reported by Storaasli and co-workers (*2*): total blood volume, 60–85 cc/kg; plasma volume, 34–60 cc/kg; and red cell volume, 26–40 cc/kg.

The method herein reported permits the rapid determination of blood volumes repeated at short intervals.

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The Oxidative Deamination of Serotonin and Other 3-(beta-Aminoethyl)-indoles by Monamine Oxidase and the Effect of These Compounds on the Deamination of Tyramine

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Recent interest in the vasoconstrictor element of blood serum which had led to the elucidation of the structure of Serotonin (*1–3*) has resulted in the synthesis of this compound (*4*) and other derivatives of 3-(beta-aminoethyl)-indole (*5*) in these laboratories. Blaschko has reported that Serotonin itself is deaminated oxidatively by guinea pig tissue (*6*).

In an effort to assess the possible oral activity of the Serotonin derivatives reported herein, it was thought worth while to investigate their deamination by monamine oxidase.

The method was essentially that employed by Beyer (*7*) utilizing manometric determination of the increase in oxygen uptake by guinea pig liver homogenate in the presence of the amines above the blank oxygen utilization. Cyanide was used as aldehyde fixative. Tyramine was run as a standard in each manometric determination. All compounds were subjected to deamination in the amount of 1.25×10^{-5} mole. Thus the theoretical oxygen uptake/atom of oxygen used was 140 mm³.

It will be seen in Table 1 that similarly to the findings in the deamination of substituted phenyl ethylamines (*8*) substitution of a single methyl group in the side chain of these compounds does not impair deamination (see compounds II, IX). Dimethyl, isopropyl, benzyl, or diethyl substitution of the aminoethyl nitrogen, precludes deamination by this system as does ethyl substitution of the beta carbon of this chain (see compounds X, IV, V, VII, and VI, respectively). The small oxygen uptake seen with compound X (5-hydroxy ring-substituted) when compared with other compounds not ring-substituted and in which the aminoethyl nitrogen atom is blocked (III, IV, V, VI, VII) would suggest possible oxidation of the ring hydroxyl group.

TABLE 1

Compound	Name	O_2 Uptake, mm³
I	3-(beta-Aminoethyl)-indole (acetate)	165
II	3-(beta-N-Methylaminoethyl)-indole (hydrochloride)	160
III	3-(beta-N-Benzyl-N-methylaminoethyl)-indole (hydrochloride)	−10
IV	3-(beta-N-Isopropylaminoethyl)-indole (hydrochloride)	0
V	3-(beta-N-Benzylaminoethyl)-indole (hydrochloride)	−10
VI	3-(beta-Aminobutyl)-indole (hydrochloride)	0
VII	3-(beta-N,N-Diethylamino)ethyl indole (hydrochloride)	0
VIII	5-Hydroxy-3-(beta aminoethyl)-indole (Serotonin) (creatinine sulfate monohydrate)	152
IX	5-Hydroxy-3-(beta-N-methylaminoethyl)-indole (creatinine sulfate monohydrate)	158
X	5-Hydroxy-3-(beta-N,N-dimethylaminoethyl)-indole (creatinine sulfate monohydrate)	28
Tyramine		140
Creatinine sulfate		0

This cannot be confirmed in the comparison of compounds VIII and IX with I and II, respectively, since all these compounds show a greater oxygen uptake than does tyramine. It is possible that this excess oxygen consumption could signify some ring oxidation other than that of the 5-hydroxy group.

Creatinine sulfate (complexed with compounds VIII, IX, and X) was not oxidized when examined separately. The rate of deamination of the compounds that were oxidized, although not illustrated, is uniformly more rapid than that of tyramine.

Since certain of these compounds showed slight depression of the basal oxygen uptake of the homogenate, it was thought of interest to investigate inhibition of tyramine oxidation by some of those compounds not deaminated. This was done by adding the compound to be tested for inhibition to both control and tyramine containing vessels. The percentage of in-

TABLE 2

Inhibition of Tyramine Oxidation (Tyramine 0.0066 *M* Final)

Compound	Final concentration	Inhibition, %
III	0.0066 *M*	37.2
IV	0.0066 *M*	83.8
V	0.0066 *M*	35.2
VI	0.0066 *M*	65.0
VII	0.0066 *M*	89.3

hibition was calculated on the basis of the maximum rates during the first 30 min.

It may be seen in Table 2 that these compounds do in fact inhibit tyramine oxidation. Since the amounts required are in the same range as the concentration of tyramine, it is presumed that the inhibition is of a competitive nature.

On the basis of this study, it would appear likely that compounds III, IV, V, VII, and X would be more active orally than the remaining compounds, since they are not deaminated by liver tissue. It should be borne in mind, however, that Beyer and Stutzman (*8*) have shown that tyramine can be recovered apparently intact from urine after oral administration, showing that hepatic deamination may not always be operative *in vivo*. Their finding, however, does not preclude reamination of *p*-hydroxylphenyl acetic acid in the kidney.

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The Appearance of Amoebae Tracks in Cultures of *Dictyostelium discoideum*

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A recently published paper of Bonner (*1*) indicates his continuing interest in the formation of the slime trail of the pseudoplasmodium of *Dictyostelium discoideum*, a slime mold of the order Acrasiales in the Myxomycophyta. A footnote appearing in the paper speculates on the possibility of the pseudoplasmodium trail being formed by slime given off by the individual myxamoebae which make up the migrating pseudoplasmodium.

Prior to the appearance of Bonner's paper (*1*), in January 1953, it was found that the individual myxamoebae of a culture of *D. discoideum* were leaving tracks or trails on the substrate of a plate of glucose medium. The observation was made under illumination of low intensity. The trails were best seen when the microscope was focused down, giving the myxamoebae the appearance of black spots with a bright halo. The trails appeared grayish. The culture on which this phenomenon was observed had been subcultured from an original collection of the organism made by D. D. Perkins of Stanford University. The pseudoplasmodia of this strain had completely lost their ability to migrate. Pseudoplasmodia were formed at centers of aggregation and sorocarps developed directly from the sedentary pseudoplasmodia. The slime mold in this original observation was grown in a two-membered culture with *Bacillus subtilis*.

Recently the work of January 1953 was repeated.[1] A culture of a motile strain of *D. discoideum* was secured from Ralph Emerson of the University of California. Both the motile and the previously used non-motile strains of the slime mold were cultured on four different media: (*a*) Emerson's yeast extract (*2*), one-half strength; (*b*) a modification of the Emerson medium in which glucose was substituted for starch; (*c*) cow dung agar; and (*d*) tap water agar.

It was found that the myxamoebae of both strains left trails on the various media used. The tracks were found about 5 days following the inoculation of the culture. In repeating the experiment *Escherichia coli* was used as the second member of the culture. It was observed that the frequency of the appearance of the tracks was positively correlated with the richness of the medium used. Glucose and yeast extract media showed many trails were formed which were well-defined when examined microscopically in reduced light at 100 ×. The tracks were only occasionally found on cow dung and tap water media.

Shown below are two photomicrographs (Figs. 1A and 1B) which were taken of a culture of *D. discoideum* grown on yeast extract medium. Figure 1B was photographed 20 min after Fig. 1A. The tracks or trails are clearly shown in the photographs. Close examination of the figures will show that the myxamoebae, which appear as black spots on the plates, have moved to new locations during the time interval and the extension of the trails is clearly seen.

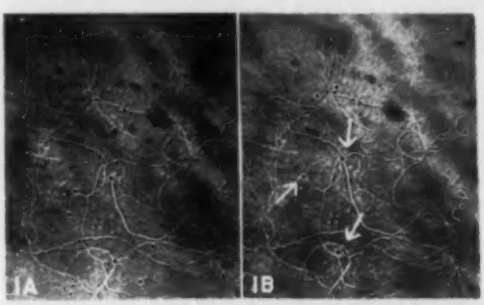

Fig. 1. A, *Dictyostelium discoideum* vegetative myxamoebae on yeast extract medium showing tracks. 100 ×: B, The same culture as 1A photographed 20 min later. Note the extensions of the tracks produced during the interval (see arrows). 100 ×.

Attempts to show that the slime trail of the pseudoplasmodium and the tracks of the myxamoebae are the same or similar substances have been unsuccessful to date. A 0.01% aqueous solution of Congo Red deposits some stain on the slime trail, but does not stain the myxamoebae tracks. The myxamoebae tracks disappear in the aqueous solution, but reappear in 10 or 15 min, presumably when the water of the staining

[1] The original observations and the repetition of this work were conducted in the laboratories of R. M. Page of the Department of Biological Sciences, Stanford University, California.

solution has been absorbed by the agar of the medium.

It is possible that the myxamoebae trails are mechanical phenomena resulting from the decreasing moisture content of the agar at room temperature. However, the correlation of the density of the tracks with the richness of the medium suggests that they are composed of metabolic products. The fact that the myxamoebae from a strain of *D. discoideum* with nonmotile pseudoplasmodia leave tracks suggests that the production of trails by the individual myxamoebae may not be intimately associated with the mechanism of locomotion of the pseudoplasmodia.

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Conformity to Social Norms and Attraction to the Group[1]

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Previous theory and research in the area of small groups has suggested that the extent to which group members conform to the group norm or standard is a function of the extent to which they are attracted to the group. Such attraction is postulated as one of the major determinants of social conformity pressure in a recent formulation of the theory of group dynamics by Cartwright and Zander (*1*). Previous research by the writer has lent some support to this assumption (*2, 3*).

If this assumption were correct, it could be expected that the degree of conformity to social pressure shown in a population of small groups would be positively correlated, to an extent significantly different from zero, with the average attraction for the group shown in each unit. A precise test of this hypothesis in a population of 28 small groups was made possible by the use of instruments for the measurement of conformity and attraction to the group.

To measure conformity in each group, subjects were asked to estimate anonymously, as accurately as possible, the number of dots in a square containing 500 dots, within a 30-sec time limit. Each subject then read out his estimate[3] and the group average was computed and announced by the experimenter. Subjects were then asked to re-estimate the number of dots; again the time limit was 30 sec.

The amount of convergence on the norm in each group was measured by the extent to which the initial standard deviation of estimates of the number of dots was reduced by the announcement of the subjects' individual estimates and their average. Such a shrinkage in original dispersion of estimates with announcement of the group norm had been found in a previous experiment (*4*), and in the present study it was again found in all but 2 of the 23 groups used in the final computations. The absolute difference between first and second standard deviations was used as a conformity index for each group.

To measure attraction for the group, subjects were asked to rate their group as a whole on an 11-point scale ranging from minus five for extreme dislike, through zero for neutrality, to plus five for extreme liking. The assumption made here was that affect, here confined to a feeling of liking or dislike for a group, is a linear dimension ranging from an extreme negative pole through a neutral point to an extreme positive pole.

Reliability of the ratings from this scale had been previously determined to be 0.80 ($N = 108$), and it was found to discriminate in the expected direction between 2 small group populations already presumed to differ in level of affect. The first of these populations was made up of 6 so-called stable groups, whose members had met together voluntarily for an average of 231 hr and were extremely likely to continue doing so. Total membership was 55. In the contrasting experimental population were 7 so-called temporary groups, whose members had met together for an average of 2.47 hr and were not likely to continue meeting voluntarily. Total membership was 53.

The average rating of their groups on the affect scale by members of the stable group population was +3.4, compared to +1.4 for the temporary group population. This difference yielded a critical ratio of 5.5, and the probability that it could have occurred by chance is less than 10^{-6}. In the present experiment, the average affect scale rating of each group by its members was used as an index of the attraction the group held for them.

The dots problem and the affect rating scale were administered to 28 classroom groups, discussion sections from an elementary psychology course, in the Easter, 1953, term at the University of Toronto. In half of these groups the dots problem was presented first, and in the other half the affect scale was presented first. Final computations were based on results from 23 groups, errors in procedure having eliminated consideration of the results from 5. These 23 groups ranged in size from 5 to 13 persons and included a total of 216.

A rank order correlation coefficient was computed between the extent of convergence on the norm in each group, measured in terms of the shrinkage of the original standard deviation, and the extent to which members liked their group, in terms of their ratings of it. The correlation obtained was −0.05 for the 23 groups, the group being the unit of correlation. The hypothesis originally suggested must therefore be re-

[1] This research was supported by grants from the Research in Humanities fund of the University of Toronto and from the Canadian Social Science Research Council.

[2] The assistance of Frank W. R. Taylor in statistical analysis of the data is gratefully acknowledged.

[3] In a previous experiment (*4*), the group was informed of individual estimates by the members, but not who had made each one.

jected as untenable. It does not appear from the present experiment, despite the reasonableness of the assumption, that attraction for the group is a determinant of social conformity.

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The Tetrakaidecahedron as the Basis for the Computation of Cell Volume and Density

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Studies by various authors (*1–6*) on the shape of central cells in compact tissues have shown that the average number of cell surfaces closely approaches the number 14 characteristic of the Archimedean tetrakaidecahedron or 14-hedron. Despite the fact that the pattern of cell faces is only infrequently identical with the arrangement of hexagonal and cubic faces definitive of the orthic form of this polyhedron (*1*) its shape may still be useful as a basis for volume determination since ". . . this is the form about which the observed shapes hover . . . it may properly be regarded as the typical shape of cells in masses. There is no rival uniform pattern" (*3*).

In sectioned tissues composed of essentially isodiametric cells randomly arranged in the plane of section the only readily measured dimension is the mean chord. It has been found (*7*) that this parameter is equal to 4 volume/surface for any solid and to π area/perimeter for any plane figure. From the data given by Matzke (*5*) it can be determined that the surface of the orthic 14-hedron of side s is $6s^2 + 8 \times 2.598s^2$, or $26.78s^2$, while the volume is $(6s^2 \times 1.414s + 8 \times 2.598s^2 \times 1.225s)$ 1/3, or $11.32s^3$. The mean chord is then equal to $1.69s$ and $s^3 = 0.207c^3$. Substituting this last equation in the original volume equation we obtain a second in which $v = 2.34c^3$.

From data available for regular polyhedra it can be shown that volume is equal to $2.91c^3$ in the 8-hedron, $2.36c^3$ in the 12-hedron, and $2.12c^3$ in the 20-hedron. It is apparent that in the range between 12 and 16 faces, regarded as most frequent in compact tissues (*1*), the average volume of orthoid cells will not vary greatly from $2.34c^3$.

A test of the applicability of this formula to cell volume measurements was made on a section of amphibian liver. Camera lucida drawings of cells in the hepatic plates were superimposed on a pattern of equiangular radiating lines, and the intercepts of these lines by the cell cross sections were measured as chords. Cumulative estimates of the volume of the average cell as the number of chord measurements increased are shown in Fig. 1. At the final mean chord value of 15.5 μ the volume was 8730 μ^3. Cell volume can also be determined in this tissue by multiplying the average volume of the essentially spherical nuclei by one plus the cytoplasm/nucleus ratio as determined by the multiple pointer method (*8*). Fluctuations between successive cumulative estimates of the ratio became and remained less than $\pm 2\%$ of the terminal value of 4.73 after 1800 pointer hits had been registered. Similar fluctuations in estimates of the average diameter of the nucleus never exceeded 1.5% of the terminal value of 14.6 μ in 100 measurements. The volume obtained by this method was 9340 μ^3. The volumes obtained by the two methods differ from their mean by less than $\pm 4\%$.

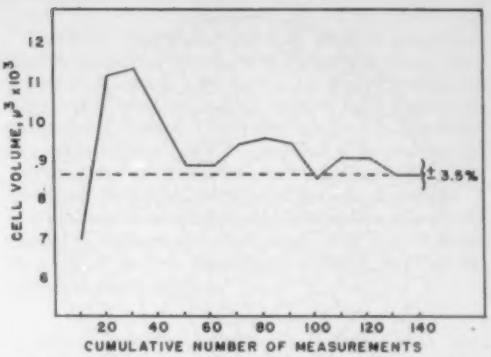

FIG. 1. Cumulative estimates of amphibian liver plate cell volume from successive measurements of the length of the mean cell chord. After 100 measurements fluctuations do not exceed $\pm 3.5\%$ of the final value.

If the orthic 14-hedron is cut by a plane perpendicular to any edge the surface of the polyhedron intercepts a hexagonal section of the plane (*5*) in which the area a is $5.66s^2$ and the average width $w = 2.77s$. Substituting $s = 0.361w$ in the area formula it becomes $a = 0.737w^2$ (for a regular hexagon $a = 0.746w^2$) and and a right prism of height w has the volume $0.737w^3$. The orthic 14-hedron has a maximum height of $1.08w$ and a volume of $11.316s^3$ or $0.532w^3$ so that its volume differs from that of a right prism of identical central cross section and height by $0.264w^3$. Alteration of the length of the edges of the 14-hedron perpendicular to a hexagonal right cross section produces squamous and columnar 14-hedra in which $v = w^3$ $(0.737\ l/w - 0.264)$ where l/w is the length/width ratio at values greater than 0.722. At lower values of l/w the tetrahedral caps of the 14-hedron would be deformed.

This formula was tested on the same group of amphibian liver plate cells used as a test of the mean chord method. The average width of 50 cells was 26.3 μ. Assuming that the cells are orthic and have a l/w ratio of 1.08, their average volume is 8620 μ^3 (compare with the volumes obtained above).

In leaf palisade epithelium the cumulative estimates

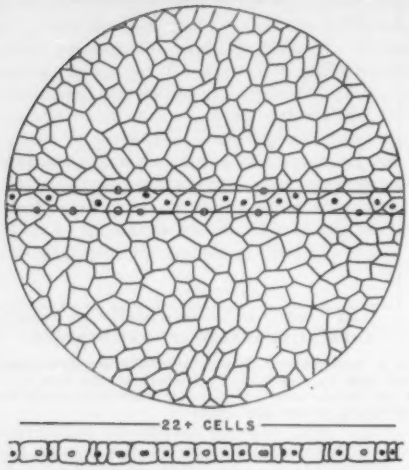

FIG. 2. Surface and hypothetical sectional views of a layer of amphibian epidermal cells.

of length stabilized within ±1% of 53.5 μ and those of width within ±1% of 12.5 μ after 100 measurements. The cumulative estimates of the length of the long (7.6 μ) and short (5.6 μ) axes of the oblately spheroidal nuclei stabilized within ±1% after 40 measurements. Equal stability of the cytoplasm/nucleus ratio (28.7) was not obtained until after 1800 hits had been registered. Palisade cell volume by the length/width formula was 5540 μ^3 and by the nuclear volume–cytoplasm/nucleus ratio method was 5025 μ^3. The two values differ by less than ±5% of their mean.

In sections tangent to the surface of an epithelium, the number of cells per unit area can be determined by direct counts per field or per unit area of an ocular counting grid. When it is necessary to make similar determinations on tissues section at right angles to the surface these can be based on measurements on the mean chord of the cell cross section measured in a plane parallel to the epithelial surface. Cross sections of epithelial cells have, in general, the six sides of the 14-hedron cross section. Since the area a of any regular polygon with n sides of length s can be expressed as $a = \frac{1}{4}ns^2 \cot 180/n$ we can substitute this for a in the mean chord formula, $c = \pi a/ns$, and obtain $c = \pi/4 (ns^2 \cot 180/n)/ns$. Simplifying we get $s = (4c \tan 180/n)\ \pi$ which, substituted in the original area formula yields $a = (4nc^2 \tan 180/n)\pi^2$ or, $0.405\ nc^2 \tan 180/n$ for any polygon, $1.405c^2$ for the hexagon and $1.460c^2$ for the pentagon.

In the stretch preparation of frog epidermis outlined in Fig. 2, an average of 23 cells is intercepted along the field diameter ($2r$) and the length of the mean chord is $0.087r$. Assuming the number of sides per cell to be 6, the area of the cross section of the average cell is $0.0106r^2$ in a field of area of $3.142r^2$. The number of cells per field is then 3.142/0.0106 or 296. If the cell outline is assumed to be pentagonal the count is 286. The actual count in the field is 287. With either assumption, the error does not exceed 3%.

The assumption that closely packed cells in parenchymatous and epithelial tissues are 14-hedra permits formulation of the cell volume and density in terms of parameters easily measured by ocular micrometry or camera lucida methods. In general these parameters are the largest linear dimensions of the cell or can be measured in terms of numbers of cells intercepting a line of optimal length (*7*). In contrast, the check method, while more applicable to cells of highly irregular shape, requires an assumption as the shape of the smaller and hence less easily measured nucleus. Other methods applicable to cells regardless of shape (*9*) are dependent upon the use of special apparatus.

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An Effect of Negative Assortative Mating on Gene Frequency[1]

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In the theory of the genetic structure of populations it is a common consideration that a change in mating system does not result in a change in gene frequency, selective mating excepted. Although this relation holds for inbreeding and for positive assortative mating, it can be shown that under at least some conditions it does not hold for negative assortative mating. One of such conditions is that involving a single autosomal gene-pair in which one member is completely dominant over its allele. The common point of departure for discussion of the effect of assortative mating (either positive or negative) on a population so composed is that deviation from panmixia occurs on a phenotypic basis, while within the dominant phenotype mating remains at random when it occurs at all (*1–6*). The simplest example is afforded by complete negative assortative mating, wherein matings occur only between phenotypically unlike individuals.

Suppose, as have Hogben (*2*) and Li (*4*), that the initial population consists of genotypes *AA*, *Aa*, and *aa*, and that, as defined, the only matings occurring be $AA \times aa$ and $Aa \times aa$. Then the next generation will consist of *Aa* and *aa* and the only mating occurring will be $Aa \times aa$. Regardless of the frequencies of these

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TABLE 1

CHANGE IN FREQUENCY (q) OF A RECESSIVE GENE UNDER DIFFERENT DEGREES OF NEGATIVE ASSORTATIVE MATING

Generation	c				
	0	−0.25	−0.50	−0.75	−1.00
0	0.50	0.50	0.50	0.50	0.50
1	0.50	0.54	0.58	0.63	0.67
5	0.50	0.65	0.71	0.74	0.75
10	0.50	0.70	0.73	0.74	0.75
∞	0.50	0.75	0.75	0.75	0.75

two genotypes the third generation will occur as 0.5 *Aa* + 0.5 *aa*. This represents the equilibrium condition under which *A* has a frequency of 0.25 and *a* of 0.75, regardless of their initial values. But since complete negative assortative mating occurs rarely if at all in nature, a more general method of calculating is needed if the effects of such a mating system are to be conveniently assessed.

Let the genotypes *AA*, *Aa*, *aa* have the respective frequencies α, β, γ; let the alleles *A*, *a* have respective frequencies p, q; let the phenotypes *A* −, *aa* have respective frequencies D (= α + β) and R (= γ); and let the mating types *A* − × *A* −, *A* − × *aa*, *aa* × *aa*, have the respective frequencies x, y, z (α + β + γ = p + q = D + R = x + y + z = 1). Finally, let the coefficient of assortative mating c be measured on the usual correlation scale. Since panmixis occurs at c = 0 and since only negative values of c are of interest here, we may set up the definition

$$c = \frac{x_- - x_0}{x_0} = \frac{y_- - y_0}{y_0 - 1} = \frac{z_- - z_0}{z_0}$$

where the − subscript indicates negative assortative mating and the 0 subscript indicates panmixis.

Then, with c = 0,

$$x = x_0, \qquad y = y_0, \qquad z = z_0$$

and

$$(\alpha + \beta + \gamma)^2 = D^2 + 2DR + R^2 = \alpha' + \beta' + \gamma' = 1$$

where primes indicate the subsequent generation. Collecting the indicated segregation classes according to genotype, gives

$$\alpha' = p^2, \qquad \beta' = 2pq, \qquad \gamma' = q^2. \tag{1}$$

And if gene frequencies remain constant,

$$\alpha' = \alpha, \qquad \beta' = \beta, \qquad \gamma' = \gamma.$$

Similarly, with $-1 \leqslant c \leqslant 0$,

$$x = x_- = x_0 + cx_0 = (1+c)x_0, \qquad y = y_- = y_0 - c(x_0 + z_0) = (1+c)y_0 - c, \qquad z = z_- = z_0 + cz_0 = (1+c)z_0$$

and

$$(\alpha + \beta + \gamma)^2 = (1+c)D^2 + 2DR(1 + c - c/y_0) + (1+c)R^2 = \alpha' + \beta' + \gamma' = 1.$$

Proceeding as for (1),

$$\alpha' = (1+c)p^2, \qquad \beta' = [2q(1+c) - c/D]p, \qquad \gamma' = (1+c)q^2 - c\beta/2D. \tag{2}$$

But when $-1 \leqslant c < 0$,

$$\alpha' \neq \alpha, \qquad \beta' \neq \beta, \qquad \gamma' \neq \gamma.$$

When c = 0, (2) reduces to (1).

Genotype frequencies for any desired generation may be calculated by (2), used iteratively. Then, since q = 0.5 β + γ, under any mating system, the effect of negative assortative mating upon q may readily be determined (Table 1). The determination of the limiting values of q (Table 1), together with the equilibrium properties of negative assortative mating, will be discussed elsewhere. From the present discussion it is clear that the mating system in question necessarily results in changed gene frequencies and that no selective action, as it is customarily defined, is at all involved in the change.

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Weather Influence in Blue Comb in Chickens[1]

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Blue comb in poultry is a pathological complex resembling shock in the early phase, with enteritis and nephritis in less acute cases. Accumulated data on field outbreaks in Florida indicated that climatic stress might be a contributing factor in the development of the disease. A maximum temperature exceeding 85° F was found to occur 3 or 4 days before cases were presented to the laboratory for diagnosis. Cold weather stress was an insignificant factor in the development of outbreaks, probably on account of the low humidity.

The possibility that the climatic stress was a local factor encouraged the study of climatic stress in another weather province. The New England states were selected because they have had experience with blue comb. Several diagnostic laboratories are available, and geographic variability is less than in many other service areas.

During 1951, the maximum temperature recorded at Boston was used to provide the state diagnostic laboratories with a prediction of blue comb. They were asked to report the days when cases were presented to the laboratory. Several factors enter into this comparison. A less observant poultryman might delay presenting the problem to the laboratory. Some cases of blue comb not due entirely to climatic factors may

[1] Florida Agricultural Experiment Station Journal Series, No. 173.

[2] The cooperation of G. Snoyenbos, G. P. Faddoul, E. Jungherr, F. E. Allen, and B. Wasserman is gratefully acknowledged.

TABLE 1

PREDICTED AND ACTUAL DIAGNOSIS OF BLUE COMB IN 1952*

Predicted	Mass. Amherst	Waltham	Conn.	N. H.	R. I.
Jun 6–12		4, 10, 13	3		
15–20	20, 23, 23	17, 23	23	20	
28–30	30	25, 25, 26, 30		30	
Jul 3–7	8, 9	3, 7, 8, 10, 10			
13–20	14	14, 14, 14, 15		15, 15, 16	
24–30	29, 30	30		17, 25, 28	
Aug 6	7, 8	6, 8, 11			
12–19	19		12, 15, 21, 21	13	23
Sep 3	2	3, 3, 4, 5	2		
11–14	9, 12	16			11
20	24, 26, 26	22, 26	19, 22, 23		
29	29				
Oct 7	1, 10	2			
16	22	14	16, 20		
29		28, 30			

* Dates in first column represent days when diagnoses were predicted. Dates in other columns represent outbreaks diagnosed.

accompany leukosis or Newcastle disease, or heavy egg production. The pathologist might separate the acute and the subacute phase, or use a different nomenclature.

The result of the survey was promising, as the five laboratories received 71 cases or in within 2 days where temperature had been 78° F or higher. Of 31 other cases, 6 occurred during January to April, and 9 from October to December. Prediction accuracy was not good in 1951, as it was thought that fowl might become acclimatized to hot weather in July and August.

In 1952 a similar prediction was made. Prediction accuracy was better during the hot months, but the influence of cold weather stress needs further review. The results of the prediction for June to October (Table 1) serve to encourage the further study of climatic influence on the development of blue comb in poultry.

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The Effect of a Noxious Stimulus in Man on the Antidiuretic Activity of the Blood

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In both man and dog, exposure to a noxious stimulus results in a marked inhibition of the diuresis induced by the ingestion of a water load (*1*). This antidiuretic response to a noxious stimulus is diminished in the absence of the neurohypophysis (*2*). Consequently, it has been postulated that the antidiuretic response is dependent upon the secretion of an antidiuretic hormone by the neurohypophysis. Direct evidence of such secretion into the circulation is not available.

With the development of a relatively simple, sensitive, and precise procedure for the assay of antidiuretic substances (ADS) in the blood plasma (*3*) it became possible to determine directly the response of the blood ADS to a noxious stimulus.

Kelsall has demonstrated that a short period of ischemic pain in the arm may inhibit the diuresis produced by a water load in man (*4*). Accordingly, healthy men were given 1000 ml of tap water and the urine voided every 10 min was replaced with an equal volume of water in order to maintain a constant water load. When the rate of urine excretion exceeded a volume of 10 ml/min for 2 consecutive periods, a venous blood sample was drawn. Shortly thereafter, the circulation through the right arm was occluded by a sphygmoma-

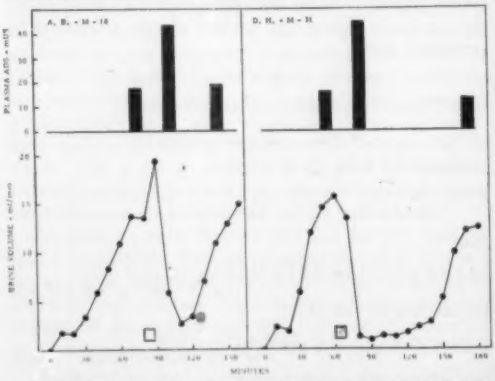

FIG. 1. The effect of a noxious stimulus on diuresis and on the antidiuretic activity of blood plasma. Ischemic pain of an arm was produced during the period marked by the shaded area.

[1] U.S. Public Health Service Research Fellow of the National Institute of Mental Health.

nometer cuff inflated to a pressure of 180 mm Hg and the subject instructed to make strong gripping movements of the hand. Ischemic pain was thereby induced. At the end of 9 min, the cuff was deflated, and the patient was permitted to void by the 10th min. Ten minutes later, a blood sample was drawn. A 3rd sample of blood was taken when the rate of urine excretion again exceeded 10 ml/min.

Figure 1 is illustrative of 2 experiments. In accord with Kelsall's observations, the production of ischemic pain of the arm results in a marked inhibition of diuresis within 10 min after the cessation of pain. The duration of the antidiuresis varies from individual to individual, as exemplified by the data depicted in Fig. 1.

The blood plasma was assayed for its antidiuretic activity and expressed in terms of equivalents of Pitressin/100 ml of plasma (*3*). Minimal quantities of ADS were found in the plasma prior to the production of pain. A significant increase in the antidiuretic activity of the plasma was noted by the time maximal inhibition of water diuresis occurred. The sample drawn after the restitution of the diuresis showed a return of the plasma ADS to its pretest concentration.

This study reveals that the antidiuretic response to a noxious stimulus such as ischemic pain of the arm is associated with an increase in the antidiuretic activity of the blood. The increase may be due to the secretion of the antidiuretic hormone of the neurohypophysis or to the release of a similar ADS from some other site. The probability that the hypothalamus is the site of origin of the ADS will be considered in a more comprehensive report.

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Manuscript received June 19, 1953.

Comments and Communications

Histamine in Mast Cells

THE contention of James F. Riley (*1*) that mast cells function not only as "heparinocytes" but also as "histaminocytes" is supported by the observation that the histamine content of the blood is well correlated with the number of circulating mast cells (basophiles), but not with that of eosinophiles or neutrophiles. Table 1 shows this correlation in the blood of various species, Table 2 in the blood of leukemic patients. These observations are in keeping with the view that blood and tissue mast cells are functionally the same.

TABLE 1*

Species	Histamine γ %	Basophiles/ mm³	Eosinophiles/ mm³	Neutrophiles/ mm³
Cat	2–5	20	850	9500
Man	2–8	45	240	4000
Guinea pig	6–25	70	180	4100
Rabbit	100–500	450	400	4200

* Histamine values according to Code (*2*), leucocyte values according to Albritton (*3*). The disproportionally high histamine value of rabbits' blood is due to its high concentration in the platelets of this species (*4*).

TABLE 2*

Histamine γ %	Basophiles/ mm³	Neutrophiles/ mm³
132	3280	154.980
250	4987	187.508
375	4425	162.070
800	7040	112.640

* Calculated from data published by Valentine and Lawrence (*5*).

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On [the Interpretation of] the Use of Calomel Half Cells to Measure Donnan Potentials

IN a recent note under (substantially) the above title, Babcock and Overstreet (*1*) discuss the interpretation of potentials obtained by inserting salt bridges into a Donnan system. They conclude that "even" if one assumes equal transference of K^+ and Cl^- ions at the bridges, the potential should be zero. Since recently a correct and very satisfying discussion of this problem has been given by Overbeek (*2*) and the related problem of ion exchange membranes treated rigorously by Scatchard (*3*), I would like only to point out some fallacies in the reasoning of this note (*1*).

The assumption of equal transference of K^+ and Cl^- ions is not sufficient to prove that the potential of the cell is zero. The authors have explicitly assumed

the equality of the two transference numbers but in writing their equation (b) they have made the further implicit assumption that these numbers are both 0.5 so that other ions, and particularly the charged colloidal ion, can not cross the boundary. Obviously both ions can have equal transference numbers (e.g., 0.4) and other ions non-zero ones [in this case $1-(2\times0.4)=0.2$].

If the transference numbers of K^+ and Cl^- are both equal to 0.5, the system is poorly suited for the example given. As mentioned above, these equal mobilities imply zero electrical mobility of the charged colloid and therefore its inability to diffuse so that a system is present which needs no membrane to separate it from dilute KCl to form a Donnan system. A membrane is only needed if the colloidal ion is mobile and would otherwise diffuse into the KCl solution.

The assumption of equal transference of K^+ and Cl^- ions is not a reasonable one. In various solutions ions tend to retain their mobilities, and their transfer numbers depend on the product of mobility and concentration. In the example given the concentration of the K^+ ion compared to that of the Cl^- ion increases in going from the KCl solution to the colloid solution. The transfer numbers could therefore remain equal only by very radical and fortuitous departures from ideality.

The driving force of the cell is not only the transfer of salt into the suspension. The colloidal ion in a typical Donnan system can escape through the salt bridge but not through the membrane. It is this tendency to escape and reach uniform concentration that could be measured by the potential of the cell (equal to the restraining Donnan membrane potential) if all other junction potentials were nullified. Salt bridges are an imperfect tool for such nullification and it is because of this imperfection that the potential depends on their salt concentration.

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Received July 10, 1953.

Dubious Experimental Procedures in Biology

IT is not the purpose of this writing to cast unwelcome reflections upon any particular report or field. It is assumed that most investigators are just as anxious to discover truth as self-appointed critics might be, therefore the considerations offered herewith may interest biologists who use poultry in some form in their experimental work. The writer has seen numerous experimental reports from time to time in which the results could be seriously questioned because of loose assumptions about eggs, chicks, or fowl. Dubious techniques are not limited to any particular academic branch of biology.

Some of the common sources of error may be classed as follows: Genetic, Environmental, and Sampling and Statistical.

Genetic. Investigators should recognize that there is inherent variability in eggs, chicks, and stock within and between breeds, strains, and families. Some of the embryos from some individual hens will die regardless of the treatment given them, whereas those from full sisters may live in spite of the same treatments. Hatchability of some hens is consistently low and vice versa.

Environmental. There is considerable lack of recognition of the possible influence of the environment on performance, including the environment of the parent stock which produces the eggs.

The following possibilities should be recognized more generally: incubation temperature affects embryonic growth rate and mortality; light and nutrition affect embryonic viability; health of hens may affect embryonic and postembryonic mortality; and serological variation has been demonstrated in chickens.

Sampling and Statistical Analysis. It is obviously possible in selecting a small sample of unpedigreed eggs to get all those eggs from a single dam. (A recent investigation report included 5 eggs as a test sample.) There are numerous cases where investigators have spent tremendous amounts of effort and money in refinement of chemical or biological material only to test the materials on small samples of eggs or chicks of unknown history.

The application of statistics in experimental procedures is increasing, but it is not universal as yet. There is room for improvement also in proper usage of statistics. Statistics will not correct mistakes in biological design, however. It should be recognized that a sample of any one breed is only a sample. A breed is merely a man-made specification and not necessarily a biological category.

It is difficult for one individual to acquire from many of our present-day graduate curricula an adequate knowledge of all the factors that might influence an experiment. It is not "cricket," of course, to find fault without suggesting possible remedies. The inclusion of scientifically minded poultry husbandry specialists in investigational teams might help somewhat. It should be recognized that there is a distinction between scientifically minded and academically trained. In some graduate curricula, objectivity is too often subordinated to academic tradition.

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Book Reviews

Human Behavior: Psychology as a Bio-Social Science. Lawrence E. Cole. Yonkers-on-the-Hudson, N. Y.: World Book, 1953. 884 pp. Illus. $5.50.

This is an important book—if an outsider may presume to pass judgment—in the history of American academic psychology. For here is a general psychology textbook whose subject matter is the person in all his complexity, rather than a series of abstract processes. Instead of surveying the traditional topics of psychology: learning, motivation, perception, cognition, memory, etc., and permitting the reader to construct, if he can, the total person from a description of these parts, Professor Cole focuses his attention on the functioning individual and attempts to explain his behavior. In this attempt he draws upon both the laboratory studies of experimental psychology as well as the field studies of sociology and anthropology. By insisting that the individual must be understood in his sociocultural context and by continuously documenting this theoretical premise, he has convincingly demonstrated (although I do not know if that was his intention) that all psychology is really social psychology.

The fact that the focus of this book is functioning person, rather than selected psychological processes, does not mean that these topics are slighted. The first six section headings, "The Nature of the Psychological Problem," "Growth and Development," "Motivation and Affective Processes," "The Modification of Behavior," "Attending and Perceiving," and "The Reasoner," indicate that the major topics of general psychology are covered. Moreover the important experimental findings are presented and their implications are discussed. But, since this book is problem-oriented, rather than topic-oriented, the individual chapters within these sections bring together relevant data from a number of separate topics as they relate to the problem under discussion. Hence, even in reading about discrete processes, one never loses the feeling for the whole.

This book, of course, is not without its faults. Specialists in the many different areas which are discussed will probably take issue with many of its details, and partisans will most certainly disagree with some of its general conclusions. This is inevitable in a book whose purpose is "to steer a middle course" (p. 24) between conflicting points of view. In the opinion of this reviewer, to take but two examples, the author's evaluation of certain psychodynamic interpretations, including his treatment of projective techniques, is somewhat less than generous; and some of his generalizations concerning the behavior of primitive peoples are much too sweeping. But the sharpest criticism of *Human Behavior* concerns its last section which is called "The Structure and Dynamics of the Self System." Almost all 200 pages of this section comprise a discussion of psychoanalysis. Such a lengthy discussion can be justified in a book that wishes to avoid the shortcomings of the usual eclectic approach to personality by presenting one systematic theory. Such was not the intention, however, in this instance. Cole is strongly opposed to psychoanalytic theory, and he discusses it in order to criticize it. Although readers will not agree about the cogency of his criticisms, they will probably agree with the reviewer that a general textbook is not the place in which to engage in a major theoretical disputation, at least not to the extent of some 150 pages.

Despite this defect this book is to be seriously recommended to anyone who is interested in the contributions of psychology to the rapidly developing behavioral sciences.

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Praktische Arbeitsphysiologie (Applied Physiology of Human Work). Gunther Lehmann. Stuttgart: Georg Thieme, 1953. (U.S. distrib.: Grune and Stratton, New York.) 355 pp. DM 33.

In contrast with psychology, the field of industrial physiology has chronically suffered from a dearth of textbooks. For a young science this has been an unfortunate state of affairs, resulting in a vicious circle "no textbooks—no courses—no trained personnel—no systematic research—no textbooks." Even in Great Britain, where research facilities and output in this field were more ample than in the U.S., no comprehensive treatment of industrial physiology has been attempted. The field and its many specific problems cannot be covered adequately in a chapter of treatises on the physiology of exercise.

In a large measure, the present volume is a fruition of 40-odd years of research carried on at the Institut für Arbeitsphysiologie founded by Max Rubner in 1913 and directed for many years by Erich Atzler. The author is the present director of the Institute, which is now located at Dortmund. However, the book is directed not only to the research specialist but also to the graduate student and to a variety of individuals, such as industrial physicians, production engineers, and other members of the scientific management team, who are concerned, in one way or another, with the physiological aspects of human work in industry. Inclusion of some elementary considerations in the text and the addition of a brief dictionary of technical terms is an expression of the author's concern for making the textbook accessible to the nonphysiologist.

The book is centered in the chapters on energy expenditure and the effects of environmental factors (especially high temperature). A chapter is devoted to the composition and pressure of air. A large section deals with the physiological evaluation of equipment (such as shovels, scythes, and wheelbarrows) and of machines; this application of physiological principles

and methods of measurement is referred to as "physiologische Rationalisierung." Its aim is a more effective adaptation of the work place and the work conditions to the structural and functional characteristics of man. In the section on special senses the author is satisfied with a general statement on the relationship between illumination intensity and performance, without direct reference to experimental evidence. Lehmann brings up the point that over the years the level of required illumination has steadily increased, paralleling man's ability to produce artificial light. Strangely enough, he does not stress the need for the differentiation between physiological needs and the practical, i.e., technological and economic possibilities.

There are several short chapters in which the practical importance of the subject matter is out of step with the available data or with the scientist's ability to solve the problems with present-day methods. One chapter deals with job evaluation. There is an interesting discussion of the problem of fatigue allowances, without providing a satisfactory solution for the overwhelming majority of jobs in modern industry. The problem of fatigue and recovery after work was discussed at some length in an earlier chapter, together with training, measurement of performance capacity, age and sex differences, and posture. The relationships between nutrition and industrial work were examined briefly. Of special interest is a graph (p. 126) indicating the reduction of performance associated with a restriction of caloric intake. It is unfortunate that empirical data are not provided, as both theoretical considerations and some experimental data would lead one to expect a smaller decrement in the light and a larger decrement in heavy work than is suggested by the author.

The book is a welcome addition to applied physiology but it does not answer the need for a comprehensive treatment of the physiological (and psychophysiological) problems in industry. The fact that the literature cited is principally German constitutes an obvious limitation.

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Scientific Book Register

Algal Culture: From Laboratory to Pilot Plant. John S. Burlew, Ed. Washington, D. C.: Carnegie Inst. of Washington, 1953. 357 pp. Illus. $1.25.

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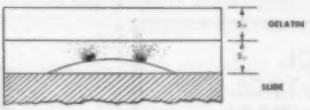

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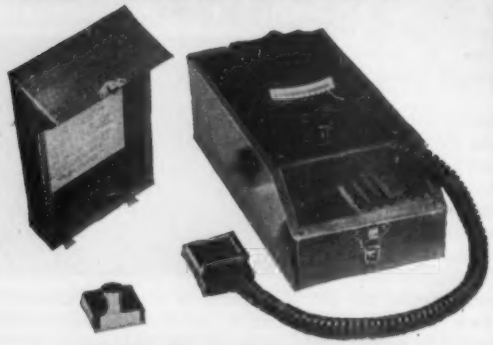

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FIG. 8–11.

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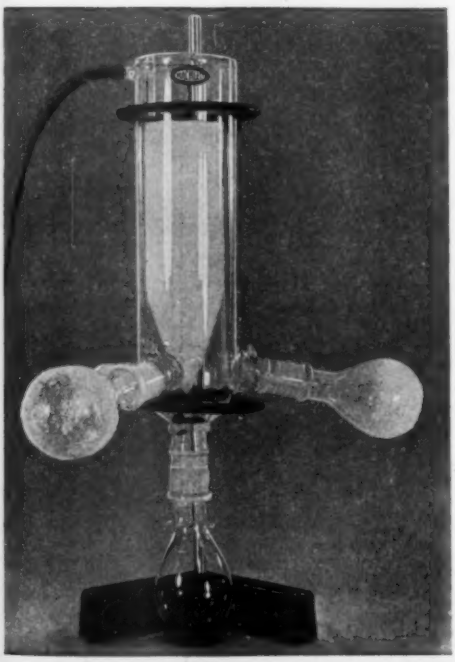

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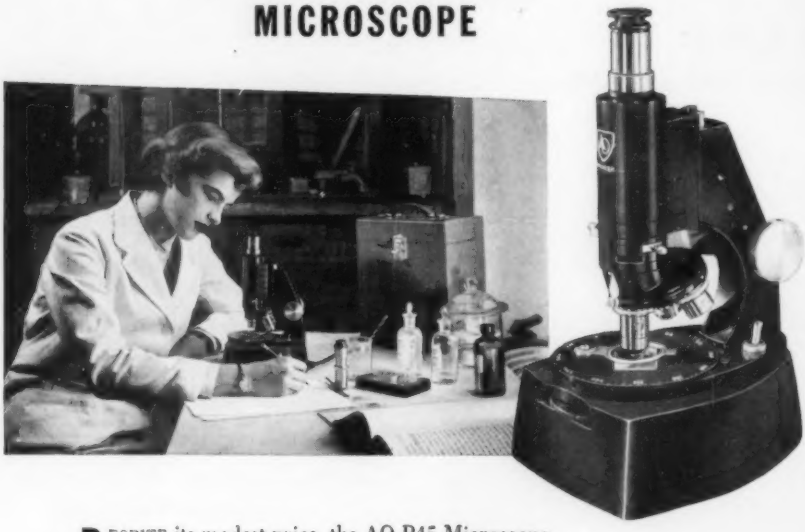

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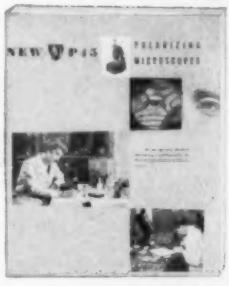

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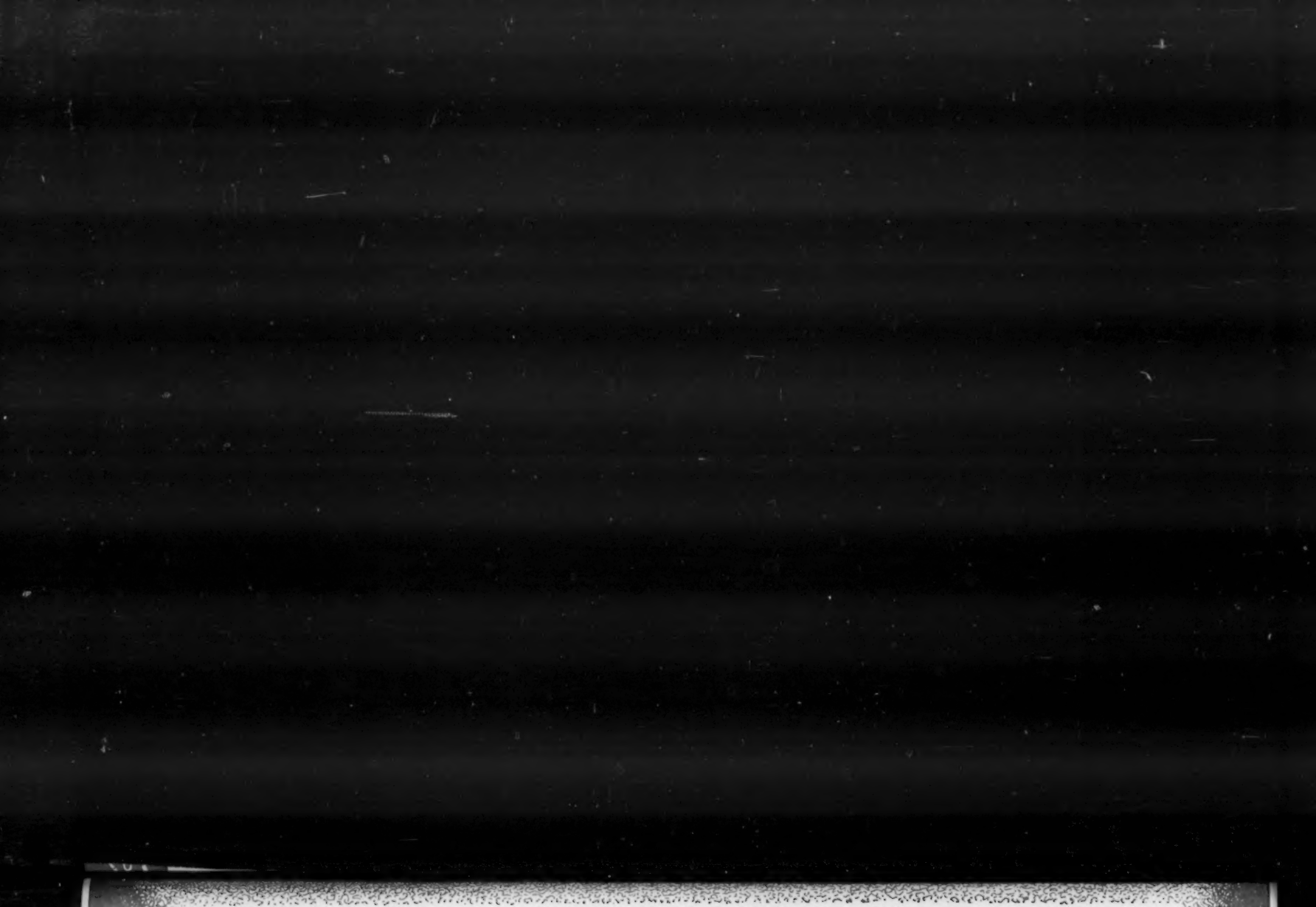
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